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ERRATA.

Page 126—Line 26, Feb. 1, 1887, should read Feb. 1, 1897.
Page 131—Line 34, Feb. 6, 1891, should read Feb. 6, 1901.
Page 132—Line 9, April 16, 1891, should read April 16, 1901.
Page 328—Line 26, "The city has no municipal water works" is a misstatement.

NINETEENTH REPORT

OF THE

STATE BOARD OF HEALTH

AND VITAL STATISTICS

OF

MINNESOTA, 1901-1902.

ST. PAUL, MINN.:
PIONEER PRESS COMPANY,
1902.

OFFICE OF THE STATE BOARD OF HEALTH
AND VITAL STATISTICS.
ST. PAUL, MINN., Dec. 31, 1902.

To His Excellency, Samuel R. Van Sant, Governor,

SIR: The State Board of Health herewith respectfully submits its nineteenth biennial report, embracing the period ending July 31, 1902.

H. M. BRACKEN, M. D.,
Secretary and Executive Officer.

MEMBERS OF THE STATE BOARD OF HEALTH AND VITAL STATISTICS.

Franklin Staples, M. D., President........................Winona

Henry Hutchinson, M. D., Vice President................St. Paul

Myron H. Reynolds, M. D., V. M................St. Anthony Park

Charles W. Mayo, M. D...............................Rochester

Samuel M. Stocker, M. D...............................Duluth

Ray F. Whetstone, M. D..............................Cass Lake

Edward Shumpik, D. M. D.........................Minneapolis

William H. Rowe, M. D.............................St. James

Henry M. Bracken, M. D., Sec. and Executive Officer..Minneapolis

PREFACE.

This report does not cover an entire period of two years, for in the process of changing the beginning of the biennial period from January to August, there was an unavoidable lapping over of time. This work is therefore taken up where the last biennial report of the board ended, and is carried to August 1, 1902.

For some time the Minnesota State Board of Health had realized the importance of a state sanitary conference or association. At its meeting Oct. 9, 1901, it was decided to call a meeting of the health officers of the state for Jan. 14, 1902. The arranging of the programme was left in the hands of the secretary of the board. Through later correspondence with the different members of the board, it was decided to extend the conference over two days.

The meeting was highly satisfactory so far as papers and discussions were concerned, but the attendance of the various sanitary officials throughout the state was not as large as it should have been. Many wrote that their city or village councils did not consider the conference of sufficient importance to send the health officer as a delegate.

The report of the sanitary conference, held Jan. 14 and 15, 1902, is given in full as a part of this report.

H. M. BRACKEN.

REPORT

OF THE

MINNESOTA SANITARY CONFERENCE.

JANUARY 14 AND 15, 1902.

MINNESOTA SANITARY CONFERENCE.

St. Paul and Minneapolis, Jan. 14 and 15.

The meeting was called to order Tuesday, Jan. 14, at 2:30 p. m., with Dr. H. Hutchinson, vice president of the State Board of Health, in the chair, Dr. F. Staples, the president, not being able to attend on account of ill health.

In opening the conference, Dr. Hutchinson said: It is not necessary to state the object of this meeting. It is a gratification to the State Board of Health that so many of you have responded to its call. It is our desire to make this a permanent organization. I will ask Dr. Bracken to serve as secretary.

The first thing to be done toward creating a permanent organization, will be the appointment of a committee on organization, and a motion to that effect will be in order. It can be appointed by the chair or by vote.

It was moved that the chair appoint a committee of three.

The motion was seconded.

Dr. Wesbrook: Perhaps it will be advisable to have more on this committee. I move that a committee be appointed by the chair, consisting of a larger number, say seven or eight men from different parts of the state.

The motion was seconded.

Dr. Bracken: Mr. Chairman, this is rather an important matter. There are a great many interests to be considered, and I would suggest that the number for this committee be left to the chair to decide upon. It will have to report tomorrow. It should be made up of men who are here and who can act at once. I would suggest, therefore, as an amendment, that the chairman be given power to appoint a committee on organization. Seconded.

This amended motion was carried.

The chair announced the names of the members of the committee on organization as follows:

Dr. Wesbrook,	Dr. Bracken,
Dr. P. M. Hall,	Dr. H. L. Taylor.
Dr. J. M. Robinson,	Dr. J. Ohage,
Mr. Wilson,	Dr. Chas. Mayo,
Dr. Cool,	Dr. M. H. Reynolds,
Dr. Tomlinson,	Dr. Spalding,
Mr. Harris Richardson,	Rev. S. G. Smith.

The president of the conference, Dr. H. Hutchinson, served as an ex-officio member of this committee.

Dr. Hutchinson: There are some announcements to be made by the secretary.

Dr. Bracken: The first announcement is quite an important one. We have a fare and one-third rate from the railroads through the courtesy of the Agricultural Association, that is now in session, and just as soon as 100 certificates have been turned in arrangements can be made for return tickets. It is important for the doctors that 100 tickets be turned in before the evening is over. Mr. Randall has now about 90 tickets.

The State Board of Health has tried to make arrangements that would be somewhat satisfactory, and it is desirable to keep people together as much as possible during the entire conference. The evening session will probably convene by eight o'clock, and between the two sessions we will all have to eat, I suppose. We have arranged to have dinner at the Commercial Club. We have no funds to entertain you; the dinner will therefore cost each one $1. The clerk has tickets which he can furnish to you upon the payment of this amount.

The purpose of this conference is to create a permanent organization. We hope such an one will be brought about as to embrace not only medical men but all who are interested in sanitary matters: the sanitary engineers, the ladies and laity generally.

Tomorrow morning's meeting will be held in the Bacteriological laboratory on the university campus. We will probably arrange for luncheon together tomorrow in Minneapolis.

You will notice on the programme that the time of meeting was only set for this afternoon session. We thought it wise to let those present vote as to the time for holding the other sessions.

It may interest some of you to know that the last published report of the State Board of Health and the report on vital statistics are on the table. Any one can secure them at this time.

Dr. Hutchinson: We will now take up the following programme:

TUESDAY, JANUARY 14TH,

AFTERNOON SESSION,

Capitol Building, St. Paul.

I. Organization. (Appoint committee for)
II. Typhoid Fever,
Discussion opened by *Dr. J. M. Robinson.*
III. Meat Inspection,
Discussion opened by *Dr. J. Ohage, St. Paul.*
IV. Sewage Disposal,
Discussion opened by *Mr. Geo. L. Wilson, St. Paul.*
V. Water Supplies in Minnesota,
Discussion opened by *Prof. J. J. Flather, Minneapolis.*

EVENING SESSION.

Capitol Building.

VI. Address of Welcome, *Gov. S. R. Van Sant.*
VII. Address, *Dr. Franklin Staples.*
VIII. The Influence of Women upon Sanitation, *Mrs. Conde Hamlin.*
IX. Tuberculosis, *Dr. C. L. Greene.*
X. The Care of the Tuberculous in Sanatoria, *Dr. H. Longstreet Taylor.*
XI. Bovine Tuberculosis in its Relation to Public Health, *Prof. H. L. Russell.*

WEDNESDAY, JANUARY 15TH,

MORNING SESSION,

State Bacteriological Laboratory, University Campus, Minneapolis.

XII. Address of Welcome, *President Cyrus Northrop.*
XIII. Tuberculosis,
Discussion opened by *Dr. J. W. Bell, Minneapolis.*
XIV. The Diagnosis of Diphtheria,
(*a*) *Clinical.* (*b*) *Bacteriological.*
Discussion opened by *Dr. J. H. Adair.*
XV. Rabies,
Discussion opened by *Dr. A. Sweeney.*
XVI. The Present Epidemic of Small Pox,
Discussion opened by *Dr. H. M. Bracken.*

AFTERNOON SESSION,

Commercial Club Rooms, Minneapolis.

XVII. The Present Status of Garbage Disposal in Minnesota,
Discussion opened by *Dr. P. M. Hall, Minneapolis.*
XVIII. Report of Committee on Organization.
XIX. Election of Officers.

TYPHOID FEVER.

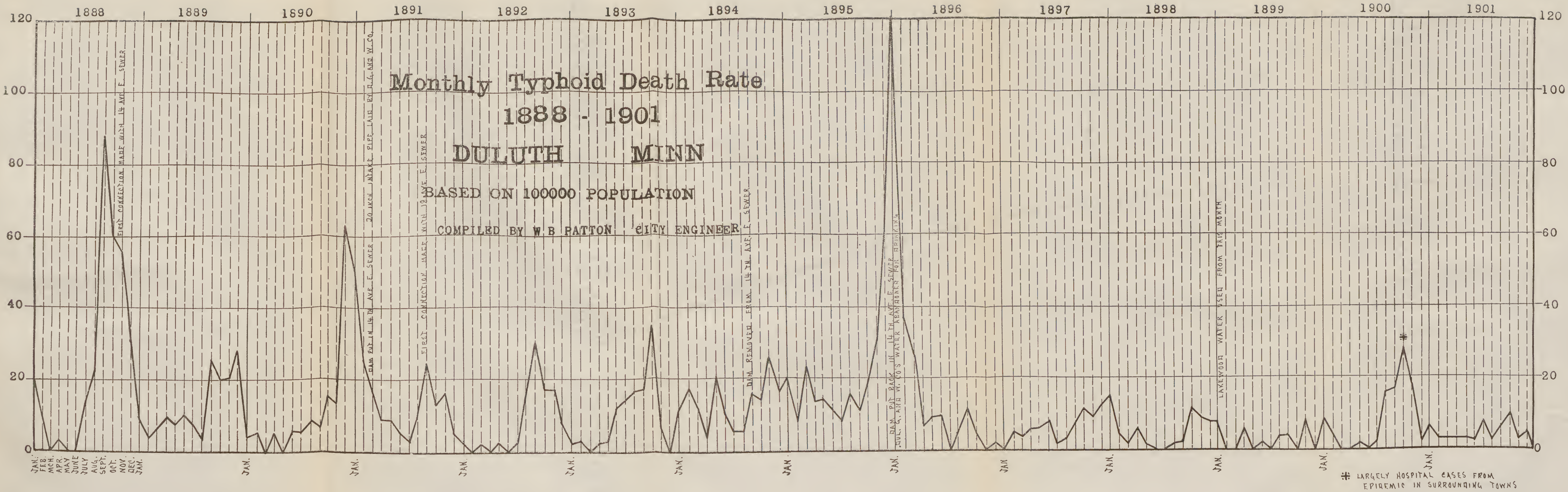
BY DR. J. M. ROBINSON, COMMISSIONER OF HEALTH, DULUTH.

Mr. Chairman and Gentlemen of the Conference: I take it that the gentleman who made out the programme for this meeting thought it especially fitting that the discussion on "Typhoid Fever" should be opened by a representative from the city which a few years ago was one of the worst hotbeds of typhoid fever in the country, but which today is comparatively typhoid free.

Regarding the experiences of this city I shall speak for a moment, later on.

The present doctrine regarding typhoid fever is, as you know, that it is a distinctly communicable disease, and that each case is to be connected with a preceding one. Only a few years ago it was generally supposed, by the laity at least, and by the medical profession to a large degree, that cases of typhoid fever might arise from dirt, from filth, or spring up of themselves; but now it is generally accepted that each case is connected, as I said, with a preceding case. A man, for example, might drink the vilest water, from the lower Mississippi, but unless some person further up stream had recently had typhoid fever, the man who used the water down stream would not have the disease.

This particular poison then, which causes typhoid fever, is the bacillus typhosus, which was originally described by Eberth and perhaps two or three other bacteriologists at the same time. It is a short, active, non-sporebearing, non-liquifying rod, not quite as long as the red blood corpuscle is wide. It is of some importance to know, without going into further description, that this bacillus will not coagulate milk, that it is not destroyed by freezing, but that it is destroyed by a temperature of 120 degrees F. Typhoid fever is produced by the introduction of this organism into the alimentary canal; i. e., the infection of typhoid fever occurs by actually swallowing some of the materials which have been discharged from the bowels of a patient suffering with this same disease. The present doctrine is that it occurs in no other way than this, except, perhaps, through the medium of the urine or saliva. The ways in which this can come about are numerous, but nearly all of the dangerous outbreaks, I think, can be traced to the infection of a water supply. Thus, where we have more than a dozen cases in a village or city, it will usually be found that the water supply is the general source of the infection.


Monthly Typhoid Death Rate
1888 - 1901
DULUTH MINN
BASED ON 100000 POPULATION
COMPILED BY W B PATTON CITY ENGINEER
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
120
100
80
60
40
20
0
JAN.
FEB.
MCH.
APR.
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
JAN.
FIRST CONNECTION MADE WITH 14 AVE E. SEWER
DAM PUT IN 14 TH AVE E. SEWER
FIRST CONNECTION MADE WITH 12 AVE E. SEWER
DAM REMOVED FROM 14 TH AVE E SEWER
DAM PUT BACK IN 14 TH AVE E. SEWER
LAKEWOOD WATER USED FROM THIS MONTH
*
* LARGELY HOSPITAL CASES FROM EPIDEMIC IN SURROUNDING TOWNS

Infection of milk also occurs, but less frequently than that of water. The typhoid bacillus does not alter the appearance of milk in which it may be growing. Typhoid fever may arise indirectly from infected water used to wash milk pails. It has also occurred to me that it is not at all improbable that cattle and sheep may sometimes bring about the infection of milk by the disease occurring in the animals themselves. Those who are particularly interested in the matter of infectious diseases in animals may be able to offer some light on this subject. Some of the veterinary physicians in Duluth, during the epidemic of 1896, claimed that at that time horses frequently suffered from "typhoid diarrhœa."

Another way in which typhoid infection may be communicated is by means of green vegetables, where human manure is used on the ground. Recently we have read of oysters and lobsters picking up the refuse along the shore, and one or two epidemics of typhoid fever arising from the use of these "scavengers of the sea" as articles of food.

The common house fly has been suggested as a carrier of typhoid infection in more than one epidemic. This is a probable theory, but one which needs some further demonstration before the ubiquitous botherer of mankind can be condemned for this variety of manslaughter.

Another possible source of infection is by personal contact. I have in mind a group of 14 nurses connected with a hospital with which I have something to do. Of these 14 nurses, five have had typhoid fever within the last two years. They have been using water which we think is entirely pure, and it is more than likely that these five cases were the result of handling typhoid patients and their bed linen.

It is, of course, possible that the typhoid bacillus may gain entrance to the mouth by being dried and carried through the air, but so far as investigation in this matter has gone, this is only theory. It has been sufficiently demonstrated that the germ is carried in other ways, but it has not been shown that the poison has been carried through the air.

In the city of Duluth, we have had an unusual and rather serious experience during a period of 12 or 13 years; and attached to this experience are some valuable lessons. As in all new and growing cities, this disease has shown itself very prevalent, partly because in new towns proper sanitary measures are not likely to keep pace with the growth of the population, and partly because the

population itself is likely to be so largely made up of susceptibles, i. e., young adults.

In the case of Duluth, it has been shown that there was an especial reason for the long continued prevalence of typhoid fever.

In 1891 there were in this city 741 cases of typhoid fever and 73 deaths. At that time the population was about 40,000. In 1892 there were 189 cases; and in 1893, 367 cases. In 1895 the number rose to 691; and in 1896 we reached the alarming record of 2,020. About one person in every 20 during that year appeared to have suffered from some form of typhoid infection.

It then became evident to the most doubting ones that there was some serious trouble with the water supply, and that this matter needed prompt investigation. The water supply of this city at that time was taken from Sixteenth Avenue East, which is in the center of the city. The intake pipe was supposed to extend about 500 feet into the lake. It was supposed that with such a very large body of water, with constantly changing currents, even along the shore in this locality the water ought to be comparatively pure. Several chemical analyses were made of the water, and although there were some indications of contamination from sewage, these reports were by no means serious enough to condemn the water for drinking purposes—but in the meantime typhoid fever continued.

Then the intake pipe was taken up, and it was found to be broken about 40 feet from shore. About 500 feet from this break was the exit of a storm sewer which was occasionally used for sanitary purposes. This sewer was closed in 1893-4 and opened again in the fall of 1895; and in connection with the opening and closing of this sewer, I show you herewith a diagram, giving the death rate from typhoid fever from 1891 to 1901, and which also shows the effect on the death rate from typhoid fever, of the damming of this sewer.

In 1897, the old water system was entirely abandoned, and a few months later the city began to be supplied with water which is taken from a point four miles distant from the extreme limits of the city, on the north shore of Lake Superior, and through an intake pipe which extends 500 feet from the shore. From that time we have had comparatively little trouble. You will notice, however, on the diagram which I show you, that there is still some typhoid fever in this community. The death rate has been somewhat kept up by the considerable number of cases which are shipped in to our hospitals every fall from the surrounding towns on the north

shore of Lake Superior and from the iron ranges. Also in the western portion of the city, which is not supplied with city water, there have been occasional mild outbreaks of typhoid. But with these exceptions, Duluth is typhoid free.

No stronger proof can, I think, be offered than the experience of this city; that a contaminated water supply will produce typhoid fever among the citizens of the community, and that this disease will continue so long as the water supply is subject to sewage contamination, or until a complete system of filtering is inaugurated.

Dr. Hutchinson: Gentlemen, the topic is open for general discussion. We will be glad to hear from any one.

Dr. Wesbrook: I was hoping that this subject would receive full discussion this afternoon. As there is a good representation from the various portions of the state, I think it will be of interest to hear what is known of methods of spread of typhoid fever so far as they have been observed by members of the sanitary conference here present. Many interesting facts have been brought forward by Dr. Robinson in connection with the spread of this disease. A number of points made by him deserve a prominent place. In the matter of excreta, I should perhaps accent a little more strongly than he did the urine of infected cases as a factor in the spread of typhoid fever, since the bacilli are found in the urine for a long time after recovery, and there is less care taken in its disposal than in the case of other excreta. Typhoid bacilli are not destroyed by drying. We should bear this in mind, and not be discouraged if we fail to trace the cause of a few sporadic cases directly to any particular water supply. Even though we recognize water as the usual and common carrier of infection, it is quite possible that in rare instances the bacilli may have been deposited upon the surface of the ground and in dust may be arrested in the mouth or nose and infection take place through the alimentary tract in the ordinary way.

So far as flies are concerned, we must recognize them and insects in general as possible carriers of disease germs. Attention has been attracted more and more to this point, particularly by what Dr. Walter Reed, U. S. A., and his colleagues have reported upon the relation of mosquitoes to yellow fever in Havana.

Some three years ago during the epidemic of typhoid fever at Camp Ramsey, the laboratory of the Minnesota State Board of Health made some investigation with flies, which were caught in sterile fly cages from one of the regimental sinks and one of the company kitchens. We obtained from their bodies a bacillus resembling B. typhosus in all respects but two.

Regarding the role played by the domestic animals in the spread of typhoid fever, we have little which incriminates them. Experiments made by Stokes and Fulton, of the Maryland State Board of Health, in which cultures of typhoid bacilli were fed to pigs and other animals, would seem to indicate that the bacilli are killed in the alimentary tract of the animals. They cannot, therefore, be distributed by the excreta of the animal if it should obtain access to typhoid dejecta whilst feeding. Animals are insusceptible to typhoid infection unless under the most artificial conditions. No one has succeeded in satisfactorily producing an infection in animals which is at all analagous to the disease in man. Cows in drinking polluted water are not a source of danger so far as the possible entry of the bacilli from their alimentary system to the milk is concerned, though as has been shown at the University of Virginia, cows wading in a stream at the point of entry of sewage, by contamination of their udders and teats may be responsible for infection of the milk supply.

Ordinarily when milk has been responsible for typhoid epidemics, infection of the milk has been shown to be due to water used for dilution or in cleansing cans, or to infection directly from cases of typhoid fever amongst those handling the milk. Whilst it is generally recognized that typhoid fever is water borne, it is nevertheless profitable to trace out the exact "modus operandi" and to determine all the channels through which typhoid fever may be carried from one individual to another.

Dr. Tomlinson: I would like to say a few words with regard to my observation of typhoid fever in public institutions, and make some suggestions as to possible lessons to be learned from that experience, which might be applicable to the study of the spread of the infective source of typhoid elsewhere. But first I want to refer to the history of an epidemic of this disease in an institution in a sister state, because of its behavior, which was interesting and suggests one of the points I want to make in this discussion.

In the early summer of 1900, there began an epidemic of typhoid fever at the Hospital for Insane, at Independence, Iowa, which lasted until November. During that time there were about 150 cases of the disease distributed generally throughout the hospital and among the employes. The source of the infection was finally determined to be in the water supply. The water supply of the institution is contained in two large tanks in the attic of the central building, which are kept filled from the city pumping station; and the bulk of the water is pumped at night. The supply of the city

is drawn from wells, except in case of fire when water is pumped directly from the river. There had been some cases of typhoid fever above the city in the spring, and one afternoon in June there was a fire in the city. As a result of this fire and the consequent pumping of water from the river, the supply main to the institution became filled with river water, which was pumped that night into the reservoir tanks. It was noted at the hospital the next day that the water was muddy, thus showing the presence of river water. Within the next month the cases of typhoid fever began to appear. The source of the infection was not determined, however, until late in the epidemic, so that everyone at the institution was equally exposed for a long time, and yet, out of a population of more than 1,200, only 150 had the disease. How is the escape of the great majority of the population of the hospital to be explained?

During the past ten years in the hospital at St. Peter there have been every fall and winter a certain number of cases of continued fever among the patients, and an occasional case of typhoid fever among the nurses. Among the patients there were also, from time to time, a case which was clinically typhoid fever. While we could account for the infection among the nurses, as the result of exposure outside of the hospital, we were at a loss to explain the presence of the disease among the patients. An interesting case occurred in the spring of 1892, which will illustrate the apparent obscurity of origin of the disease in the hospital. A woman, who on account of her violent excitement was not out of the wards for two months, and who spent most of the time in a crib, with only a straw tick to sleep on, was found one morning to be very stupid, and suffering from diarrhœa. So far as could be determined there was no evidence of disease except the fever and the symptoms referred to. Two days afterward, however, she had hemorrhages from the bowels, and died within a week after her illness was first noticed. The post mortem examination revealed the typical lesions of typhoid fever. The straw in the tick, moistened by the urine of the patient, was the undoubted source of infection in this case. We have better methods of caring for our people now, but it was not until the discovery of the agglutination test of Widal, that we were able to make a positive diagnosis, and discriminate between the different cases of continued fever which developed in the hospital. With the use of more accurate means of diagnosis we found that most of our cases of continued fever were really typhoid. Each season we have carefully tried to trace the source of infection, but without success. It was noted, however, that the

patients attacked were practically always those of slovenly or filthy habits. Of the possible sources of infection we first eliminated the water, then the milk. Finally we made cultures from scrapings from the walls and floor of the wards occupied by the patients who were infected, but with only negative results. Very few of our cases resembled typhoid fever in their clinical manifestations, except as to duration, and not always in this respect. These outbreaks always begin in the fall after the weather begins to get cold and the patients are more closely confined to the house, so that opportunity for contact with the source of infection, if it were out of doors, is less than during warm weather. Then, too, only an occasional patient is ill with the disease, while if there is any local nidus of infection, all are subjected to it. The history of the disease in the hospital at St. Peter and the epidemic I described as occurring at Independence would indicate the possibility that many people may be infected with the cause of typhoid fever and only a comparatively small number suffer from the disease. This conclusion suggests the point I want to make. People who are not ill with the disease may harbor the disease germ in the alimentary canal, and through their bodily excretions be the means of disseminating the infection, just as we know does often happen in such diseases as smallpox, scarlet fever, diphtheria, etc., where the contagion may be carried in the clothing, or on the persons of those who do not themselves have the disease. I believe with Dr. Wesbrook, that the urine is a very common means of transmitting the infection of typhoid fever, and an especially dangerous one, on account of the indiscriminate method of its disposition. The fact that the disease in the hospital is confined almost exclusively to the slovenly and filthy patients would suggest that their personal habits brought them in contact with sources of infection to which the rest of the population were not subjected. And when we consider how easily the infection may be spread from the urine of the convalescent, or from the discharges of both the bowels and bladder in the so-called walking cases; as well as from the probably very large number of cases which are never diagnosed, it is not surprising that it is so difficult to get rid of and often to find the source of infection. We have, in our experience, found the bacillus in the urine a week before it could be recovered from the feces, and also a long time after convalescence was established, and this has suggested to me the probability that the source of infection among our patients may be substances which they pick up when out of doors, and put in their mouths, which may be infected. Then that the organ-

ism may remain quiescent until an attack of indigestion, or a cold, lowers the vitality of the individual sufficiently for the organism to get a chance to develop in sufficient numbers to give rise to the disease.

I know nothing personally of infection by flies, but remember the report of the expert commission sent by the government to investigate the epidemics of typhoid at the different military camps in the south during the Spanish war. Their report attributed the prevalence and rapid spread of the disease entirely to the flies.

Dr. Boehm: In St. Cloud we are somewhat interested in typhoid fever at present. When I first went to St. Cloud in 1884, I was attending the normal school there. In that institution there occurred one case which had been carried there from North Dakota. I think that was the only case, and I have heard the doctor that was in attendance at that time say that it was the only case that had been in St. Cloud for many years. When I returned to St. Cloud a few years later I met the same doctor, and we got to talking about typhoid fever. There were then very few cases. Dr. Dunn can probably tell you more about that time.

A few years later Little Falls put in a sewerage system and the sewage empties into the Mississippi river. Brainerd, above Little Falls, has a sewerage system, and near Brainerd is a lumber camp which was filled with patients who were suffering with typhoid fever—some 30 cases. They had their run of typhoid fever in the fall. Last winter St. Cloud had an unusually large number of cases of typhoid fever, and of all the cases that I have been able to collect data from they all had used city water, i. e., water out of the Mississippi river. I recall three instances, one where the young lady was attending a certain school where we have city water. She was taken down with typhoid fever. Her little brother, attending another school where they had well water, was not taken down with the disease. The rest of the family drank well water at their own home and were not taken down.

Another family with two children attending a school where city water was used, were taken down with typhoid fever, and none of the rest of the family who drank well water from their home were taken down. This, together with what I had read and heard concerning the disease in Duluth, led me to believe that our source of infection must have been due to the city water, because I have not been able to find one case of typhoid fever where the individual had not been drinking water from the Mississippi river all the way

from two weeks to six weeks prior. It has been stated by one of our aldermen, who has finally asked that an investigation be made, that the city of St. Cloud has spent nearly $4,000 in preventing and quarantining the epidemic of smallpox, and he asks his brother councilmen, why not spend a few dollars in finding out the source of typhoid fever, which seems to be killing more people and is certainly more dangerous to health than smallpox. I think this is a wise suggestion, not only for the city of St. Cloud, but for its physicians and the state.

There is one question brought to my mind by Dr. Robinson's referring to the cows drinking water perhaps contaminated with the germs. Will that effect the milk? That, of course, can only be determined by repeated examinations of milk with that end in view, and is perhaps the work of both a veterinarian and physician or bacteriologist together. I believe the greatest number of typhoid fever cases in any locality is usually found along the river. I believe if we were to follow the Mississippi river and visit towns adjoining it we would find that where the water supply for drinking is taken from the Mississippi river, the proportional number of typhoid cases and deaths from typhoid fever is greater than the proportional number in places where they do not take their water supply from streams; that is, streams that have no sewage or excreta emptied into them.

I would like to hear from Dr. Wesbrook, or someone else who is competent to know, whether it would be possible for the germ to live and be found in milk if the cow drank contaminated water.

There is another question. Certain cases arise where the water is sterilized or boiled. A great many families boil the water, and you will find a case of typhoid fever in the family. The investigation I have made shows that the vegetables are washed with cold water from the river, and you can readily see that one or more bacilli might readily cling to the vegetable and that would account for a case of typhoid fever where the drinking water was boiled.

In closing this, I would say that disinfecting the excreta where we have hospitals, or a large number of cases of typhoid fever, ought to be compulsory, just as in quarantining smallpox, etc., and we ought to go after it just as vigilantly and rigidly if we wish to accomplish anything. Why not have a state law and enforce it, making it compulsory to disinfect excreta in all cases of contagious and infectious diseases?

Dr. Hutchinson: I would like to hear from Prof. Russell, of Wisconsin.

Prof. Russell: There is only one phase of the question that I can say anything about, and that is regarding the danger of typhoid coming from infected milk. This possibility of infection is often neglected and attention has only recently been drawn in an adequate manner to this source of infection. The typhoid germ is able to live and grow in milk because it is able to develop in an acid medium. The way in which milk becomes polluted is quite interesting. Some of the ways have already been noted. One is that which occurs from the pollution of cans and milk utensils. A very severe epidemic occurred in Connecticut in 1895, where 385 cases occurred in a town of 20,000 inhabitants, and 97 per cent of all of these cases occurred on the route of a single milkman. This in itself was sufficient to establish the relation between the disease and infection of the milk in some way or other. Examination of the surrounding conditions showed the cans to be carefully cleaned in a perfectly satisfactory manner. They were thoroughly washed and thoroughly scalded, but after they had been properly cleaned they were rinsed out with cold water. The water used for rinsing purposes was taken from a polluted well, and the small amount of water adhering was sufficient to pollute the milk, so that the disease occurred. This is the most common way in which the disease is spread through the milk supply.

There are several other ways, some of which have been spoken of. The fact that the typhoid organism may appear in the excreta from the convalescent patient, more particularly in the urine, shows that the infection may be direct from the patient to the milk. We have those types of the disease where the patient may not be sick enough to take to his bed. Then again we have those forms where a second person serves as a medium for the transmission of the organism. Some persons living on the farm may act as a nurse to an infected person, and also attend to the handling of the milk. In this way a number of outbreaks have been traced to infection through this indirect medium of a second person carrying the typhoid contagion from the original person in the milk supply.

I think that health officers and sanitarians should strive to educate the milk producer to separate absolutely the handling of the milk from any such cases of typhoid fever. Wherever there is a case of typhoid fever, scarlet fever or diphtheria, etc., in a family of the milk producer, the greatest care should be taken in regard to either direct or indirect infection, because the evidence is constantly accumulating which indicates that this relation frequently

exists. Over 100 epidemics have now been traced to polluted milk supplies which have been infected in one or another of these ways.

Dr. Hutchinson: Since our meeting was called to order I am told that we have Dr. Gordon Bell, of Winnipeg, here, and we would like to hear from him.

Dr. Bell: Typhoid fever is very prevalent throughout our province. Some features of it we cannot well understand. We find it occurring in isolated farm houses all over the country, due to the water supply. We have been able in several cases to trace it to direct infection.

We have some families using the artesian wells who have had the disease. I will speak of one case in particular. On this farm artesian well water was used, but the men's clothes were taken to a neighboring farm to be washed, and this family, who did the washing, had the disease. The typhoid fever was carried home in the clothes. We have had several cases where we have been able to trace the infection to the milk supply. We were able, from records in the city health office, to point to 23 cases suffering from typhoid fever, all cases being customers of one milkman who had the disease. The precautions taken by this man were fair. The cans were cleaned with boiling water, but he had evidently contaminated the milk from the hands. I think the carelessness in the handling of milk is one of the most important points to be considered.

Dr. Greaves, of Northfield: I have not had any great experience with typhoid fever in our city, but the disease has prevailed to quite an extent in the neighboring country districts. In these cases that I saw I was unable to trace the infection from one patient to another. At the time I refer to there were some eight or ten families that had the disease, with probably 40 cases. In every instance there were two or three members of the family ill with the disease. I do not recall finding any two families using the same supply of water.

Dr. Robinson, in closing the discussion, said: There are other topics on the programme which touch upon this subject and which will lead into a direct discussion of typhoid fever.

I am glad that Drs. Wesbrook and Tomlinson spoke. I remember that I had a case of typhoid fever in a nurse, which I attributed to contact with the urine of a patient. The nurse was on duty only three days, but she had occasion to measure the urine and to change the bed linen, and I am quite certain the nurse contracted the disease in this way.

Dr. Tomlinson spoke of the possibility of the germ existing and being communicated by persons who are not suffering from typhoid fever. There are a great many cases of typhoid which were perhaps formerly considered as some other disease. I think there are a great many cases of light character, which we sometimes fail to recognize. During the epidemic of 1896, I had one or two cases in which I could only make the diagnosis with the aid of the Widal reaction. In one instance the young lady was sick 14 or 15 days with a very slight fever, the temperature never being above 101 degrees. There were no symptoms other than the temperature, but th blood gave the typical Widal reaction, showing the existence of the disease.

Dr. Bracken: Mr. Chairman, the next paper on the programme is on meat inspection, but Dr. Ohage is not here. I would therefore suggest that the discussion on sewage disposal and water supplies be taken up together, as the subjects are closely related.

I would also suggest that before we go into these subjects a vote should be taken as to the hour we should meet this evening, and I would also like to have an idea as to who will be disposed to go to the Commercial Club for dinner this evening.

Dr. Hutchinson: If there is no objection we will pass over "meat inspection" and take up Topic 4. The motion in regard to the hour for convening again this evening would be in order.

Dr. Boehm: I move that we reconvene at 8 o'clock this evening in this room. Motion seconded and carried.

ON SEWAGE DISPOSAL.

BY GEO. L. WILSON, ASSISTANT CITY ENGINEER, ST. PAUL.

For the purpose of this paper, sewage may be classified as the mixture of water and refuse from,

1st. Isolated houses.

2nd. Isolated institutions, either dwellings or manufactories.

3rd. Towns or cities provided with sewers which bring sewage to some common point.

The disposal of the liquid and solid refuse from dwellings in the primitive manner common to all has been to deposit the same where it could decompose without offense. Following the gathering of many persons in one place and the increase in wastes to be disposed of came the question of the final disposition of these matters, and it is surprising to note that, until very recently, about

35 years, in our most highly organized communities (London 1865, Paris 1867), the disposal of the most offensive wastes was made by direct collection by house to house methods, then burial in the earth or midden heaps.

With recent advances in the comforts and conveniences of living has come the direct supply of water to buildings and dwellings, and water carriage has been adopted practically by most communities as the proper method for removing wastes. It may be of interest to note that this has come to be the fact only during the last 25 years or less, so recent are modern sanitary methods.

As water removes the refuse from our buildings it is but natural that the same vehicle should be continued in service, and hence the practice of using streams of flowing water to remove the sewage became the established custom when practical.

The growth of cities and the increasing density of population with the attendant increase of sewage has made this custom not only fail to give relief in many places, but has created at the same time unbearable nuisances.

The question as to the amount of sewage it is feasible to discharge into a given stream without causing trouble has been studied much. Some of the conclusions reached are as follows:

Rudolph Hering, after investigations made under direction of the Massachusetts State Board of Health, considers a flow of seven cubic feet per 1,000 persons a safe proportion. This is calculated to equal fifty volumes of water to one volume of sewage.

Mr. F. P. Stearns, engineer of the same board, considers that 1.4 or 2.5 per cent of sewage entering a stream will create trouble, but states that 130 volumes of water to one volume of sewage will be sufficient dilution. These proportions are such that the stream will not be offensive to sight and smell.

Where there is no positive nuisance created in a stream the presence of sewage makes it highly dangerous to use as a source of water supply.

One of the noted examples is the city of Lawrence, Mass., which takes the water for 62,000 people from the Merrimac river, having a population on its watershed of some 317,000 above Lawrence. The proportion of sewage at an average stage of the river was one part to 200 parts. As a result the city found it necessary to filter its water supply on account of the pollution of the river.

Albany, N. Y., has been compelled to construct expensive filters for the same reason, and as a result typhoid fever decreased to less than one-third its former amount after the starting of the filter.

Nearer to Minnesota are the filter plants at Ashland and West Superior, Wis., made necessary by contaminated water. Many other towns could be named. In fact the question of filtering the water supply is today one of the utmost importance in the water supply of our cities.

The most interesting and best known question of river pollution is that at present existing between the cities of Chicago and St. Louis.

The conditions on the Illinois river between Chicago and the Mississippi river since the opening of the drainage canal have been investigated by the trustees of the sanitary district of Chicago and by the Illinois State Board of Health. Some results of the examination by the state board, as given in its report for 1901, are as follows:

"The great mass of organic filth passing Lockport (the end of the drainage canal) is practically destroyed or rendered harmless by conversion into stable compounds, while the myriads of bacterial cells depending on it for their existence have likewise disappeared. Save for the presence of inorganic remains, the chlorides and nitrates of oxidation, there is nothing here to distinguish the Illinois from its unpolluted tributaries, which hold dissolved, mainly, the organic products of decay and vegetable matter."

"To determine the best conditions for the rational bacterial treatment of rivers is one of the interesting sanitary problems of the future."

"A seriously polluted water becomes pure again after flowing a certain distance. Pathogenic bacteria and sewage bacteria decrease as organic matter decreases."

The results of the investigations of Chicago and St. Louis officials have not as yet been made public, but the people of St. Louis feel far from satisfied that the river is not seriously polluted in spite of the additional volume of 300,000 cubic feet of lake water per minute added to the river with the sewage.

The Illinois law placed the supply at 20,000 gallons per 100,000 people per minute. A suit in regard to this pollution of the Illinois river is now pending in the United States court.

The efforts to find some satisfactory substitute for this use of rivers have been many, but no general solution of the problem has been found that will apply to all places.

The conditions of European cities in this direction are in advance of those in American cities. Greater care is taken to dispose of the sewage in a harmless and inoffensive manner than in

the United States. It is also well to remember that greater attention is paid to the furnishing of pure water.

Towns and cities in the United States, so far as practical, are using disposal into running streams or lakes. The places that have other methods in use are those which have been compelled to do so by local conditions, and it should be remembered that more and more our towns and cities must adopt similar methods, for already the courts of Massachusetts, Connecticut, Ohio, Illinois, Wisconsin and other states have decided that property owners along flowing streams have a right to the use of the water practically unpolluted.

Taking up some other methods of disposal, they may be classified under:

Irrigation.
Subsidence or Sedimentation.
Chemical Precipitation.
Septic Treatment.

Irrigation.—This general treatment may be divided into:

1st. Broad irrigation in which the sewage is run to the surface of land especially prepared for the purpose, with the object of having the sewage used by crops of growing vegetation. This requires in England about one acre of land for 100 people, with a sewage flow of thirty-eight gallons per capita. In India one acre is found to take the sewage from 500 persons at fifteen gallons per capita. Irrigation is extensively used and in places where growing crops need irrigation it appears to be successful.

For example, in the United States the following are among the places where sewage is so used: Colorado Springs and Trinidad, Colo.; Fresno, Pasadena, Redding, Los Angeles and Santa Rosa, Cal.; Helena, Mont.; Cheyenne, Wyo.; Stockton, Cal.; places from 2,000 to over 50,000.

Some of the difficulties are:

1st. The unsuitability of the available land.

2nd. Local opposition and high prices demanded for the land to be used.

3rd. Failure to make sale of sewage-watered produce profitable.

From all information the conclusion is that in Minnesota the conditions of climate and soil are not such that irrigation would be successful as a method of disposal, unless in connection with other processes. It promises to be of value under favorable conditions,

as, for example, when the sewage can be applied to growing crops during periods of drouth.

Intermittent irrigation and partial irrigation, including previous sedimentation or chemical precipitation, are modifications of broad irrigation, and, while subject to some of the same objections, if used in connection with filtration methods give excellent results. Perhaps the best known and most successful irrigation and filtration works combined are at Brockton, Mass. An example of filtration and sedimentation is the Rochester, Minn., State Hospital, and of filtration alone the United States Soldiers' Home at Milwaukee.

Subsidence or Sedimentation.—Many plans of precipitating the suspended substances have been tried with varying degrees of success. All projects, besides the improvement of the effluent, produce a sludge that is both difficult and expensive to dispose of.

In small quantities it is deposited in pits or on low grounds and covered with earth. In some localities a small price has been obtained for it.

In large amounts it is treated by filter presses and the solid residuum burned, sold as a fertilizer at a very small price, or deposited in low ground for filling.

In chemical precipitation lime is the agent found to give the best results at a minimum of cost. Sulphate of iron, of aluminum, the double sulphate of aluminum and potassium, are used alone, and in various combinations.

Many patented mixtures and preparations have been made and used. These experiments have been more largely carried on in England than in the United States, as more towns have been compelled to purify their sewage than in this country. English cities in consequence are much in advance of ours in the disposal of sewage, and it is stated by Shaw, in his work on municipal government, that more money is spent on sewage wastes than on the water supply. Large cities like Sheffield (350,000), Birmingham (400,000), Glasgow (750,000), use precipitation works in connection with irrigation or filtration beds.

After mixing the lime or other precipitant, in solution, with the raw sewage, it is allowed to pass into tanks, where subsidence takes place and the clarified effluent passes off. The tanks are generally so arranged that this action shall be continuous, except where the tanks are emptied to remove the sludge. Probably the best example of chemical precipitation works in this country on a large scale is at Worcester, Mass., where the sewage from

a city of 118,000 people, with large amounts of manufacturing wastes, is treated with very satisfactory results. The annual cost is 0.41 per capita and amount treated 13.1 million gallons per day.

Sterilization.—In connection with chemical treatment it is proper to mention that many inventions have been tried, using heat, electricity or chemicals, but without devising plans practical of application on a large scale. For small amounts of sewage some of these methods are used with good effect.

A good deal has been claimed for electricity; generally by the treatment of sea water or brine, first electrolyzing the water and then adding it to the raw sewage, using it for flushing sewers and streets. This was tried by a number of English towns, but has been abandoned.

It was used with success at Havana in 1899 as a means of preventing yellow fever and other diseases, and is, doubtless, a valuable aid in preserving sanitary conditions under special difficulties when expense is not the most important item.

Septic Treatment.—What is known as the "Septic" process has been growing in favor recently, either as a complete treatment or, more usually, combined with filtration.

It is claimed to be an adaptation of natural processes by which the solid portions of the sewage are reduced through the joint action of bacterial and chemical processes to gaseous and liquid forms and so pass off with the effluent.

The foundation theory is that in the decay of organic matter the fermentation and putrefaction which take place depend, as proved by Pasteur, on the action of living organisms or bacteria, classified by him into aerobic and anaerobic.

The first class acting without the presence of oxygen attack solid substances and reduce them, by fermentation and chemical change, to compounds which are ready for the second step, when bacteria acting with the aid of oxygen ("*aerobic*") can finish the breaking up process of oxidizing and reducing the organic matters in large degree to liquid and gaseous forms, at which point the action of nitrification reduces to other stable compounds.

The application of these processes of decomposition is called "Septic" treatment or "treatment producing putrefaction." This is the breaking up of animal or vegetable matter into simpler and stable compounds, through the agency of the putrefaction ferments or bacteria.

The practical application of the theory to sewage disposal is brought about by allowing the crude sewage to pass into tanks,

where, protected from light and air, it remains long enough for the action of the anaerobic bacteria to be performed. This requires differing lengths of time, depending upon the composition of the sewage, varying from eight to twenty-four hours or over, and determined by observation. During the first stage a scum forms over the surface, protecting the liquid from light and air. After this stage the sewage passes on to allow the action of "aerobic" bacteria to complete the process of oxidation and nitrification. As these require the presence of oxygen the sewage is conducted from the tanks onto some form of filtering bed which provides means of exposing the sewage in thin films to the air. Heavy substances settle in the tanks during the first stage and slowly decompose. It is found that the solid portions which finally remain are much less in quantity than in any other method of treatment. The amount of sludge from spetic tanks is placed at less than one-seventh of the amount from precipitation works.

The results obtained by this method of purification, in connection with filter beds, are very satisfactory and the operation of septic tanks has been attended with success, not alone on account of the satisfactory clarification of the sewage, but also on account of its economy when compared with chemical and mechanical processes.

The use of septic methods is extending rapidly both abroad and in the United States. The nearest city to adopt it is Madison, Wis., which has just installed septic treatment, and the information is given that the plant is working well.

WATER SUPPLY.

BY PROF. J. J. FLATHER, UNIVERSITY OF MINNESOTA.

What I shall say on this subject will be with the object of producing some discussion on this interesting topic, although it is evident that time will permit us to discuss only some of the minor problems connected with the matters of water supply.

From what experience the writer has had with town committees as consulting engineer in investigating the available sources of water supply for new systems, and in extensions annd improvements in existing systems, the principal thought seems to be quantity of water. Quality is almost invariably neglected, or, if considered at all, the quality is judged by the color and taste. While it is reasonable to assume that good water is clear and limpid and

is not objectionable to the taste, on the other hand it is not always safe to assume that clear water, which is pleasant to the taste, is potable and safe for a community.

The purity of the water depends upon its sources and upon the polluting or purifying influences to which it has been subjected. It is well known that in a community using water polluted with sewage the general health gradually is lowered and the death rate increased in a corresponding degree.

Among the diseases which are known to be water-borne, typhoid fever, cholera, diarrhœa, dysentery, and similar forms of disease are the most common, and may be directly traceable to sewage contamination. This is so well recognized that a presentation of the facts to prove it would be out of place at the present time. While the average typhoid fever death rate per hundred thousand people may vary from five to six with the best spring water for domestic supply, the rate approximates even as high as three hundred when the water supply is taken from polluted streams.

While the public water supply of a town or village may be comparatively pure, we find instances of more or less frequent occurrences in which typhoid occurs in these towns to a marked extent. That is, in those localities where each householder has his own well dug to a depth varying anywhere from eight to twenty feet, laid up with wooden curbing or frequently laid up with stones set dry, there is every opportunity of the water being polluted by local contamination. Frequently this is supplied by the proximity of outhouses and closets or cess-pools and stables, which are usually located close to the well—the idea being to have all close to the house, so as to have them handy.

Sometimes this pollution occurs due to surface drainage water leaking into the well, the drainage water itself polluted by the refuse from the house or stable; at other times this pollution occurs due to inflow of the ground water, which may be contaminated from sources at a considerable distance. It is impossible to say how far the well should be placed from a privy, as this will vary with the topography of the ground and other conditions. This has been placed by some writers as not less than 100 feet, but the writer has known of serious contamination occurring where such sources were several hundred feet removed.

It is sufficient to state that too great care cannot be exercised in these matters, and periodic analyses should be made to ascertain the present condition of the drinking water. A little additional expense in laying the walls of the well and in cementing

them inside and out with a good coat of Portland cement plaster will generally prevent the inflow of impure surface waters.

Driven or drilled wells with the outer casing of iron pipe sunk to some considerable distance below the surface will aid very materially in obtaining a pure water supply either for domestic or public purposes. Especially is this true if the pipe passes through an impervious layer of clay or hard pan before striking the water-bearing layer.

If, in addition to this, proper precautions are taken in the placing and construction of stables and outhouses, and with vaults properly cemented, better and more suitable water supplies will be obtained.

The true financial aspect of the case is one which does not usually occur to the householder or citizen, and cheapness in these matters is very poor economy. Possibly you recall the case of the fever epidemic which occurred in Plymouth, Pa., a few years ago, in which there were over 1,100 cases of typhoid fever and 114 deaths, among a population of 8,000, as the result of the discharge of the feces from a single typhoid patient into the water of a relatively small impounding reservoir.

The cost of this epidemic was calculated with unusual care. The care of the sick alone cost in cash $67,100, and the loss of wages for those who recovered amounted to something like $30,000. The 114 persons who died were earning before their sickness at the rate of $18,400 annually. The incident shows how really expensive the lack of proper sanitary precautions may become.

It is pretty safe to assume that where the population is at all congested shallow surface wells are inimical to public health and should be used with the greatest caution.

As a general rule one is able to determine by inspection, without any chemical or bacteriological examination whatever, whether or not such wells are satisfactory or polluted. Knowing the depth of a well, its construction and proximity to outhouses, one is almost always correct when he says that a shallow well in a thickly settled district is probably contaminated; and a subsequent sanitary analysis will generally corroborate this.

In determining a suitable source of supply for public purposes a sanitary analysis should invariably be made, not only of the proposed source, but of a number of supplies in the immediate vicinity, including shallow and deep wells, and river or lake, if there be such. The value of such an analysis is not so great *per se*, but, as Mason has so happily expressed it, "It aids the engineer in interpreting his

judgment," and must be considered as corroborative of the data which he collects at the same time that he obtains the sample of water.

In other words, the personal examination of the surroundings should have even greater weight than the analysis itself. That this is lost sight of frequently is very apparent.

I have talked with men throughout the State whose idea seems to be that the withholding of all data as to the origin of the supply and its environment is necessary in order to get a correct and unbiased analysis of the water. Others seem to think that this is necessary in order to test the chemist's knowledge, and have even gone so far as to purposely mix waters for reasons best known to themselves.

In a matter of so much importance as a public water supply too great care cannot be taken in order to obtain the most satisfactory and safest results, and while a chemical analysis does not in itself determine the degree of purity of a water supply, it does materially assist the engineer in deciding upon such supply and should always be made. If any doubt exists, frequent analyses should be made from time to time in order to get more accurate results.

The available statistics indicate that surface water supplies, except those which have enormous storage reservoirs, cannot be generally regarded as safe. Except in the case of some of the smaller streams which pass through sparsely populated districts, it is safe to say with our present knowledge that most river waters should be filtered. The use of river waters in their natural state or after sedimentation only, is a filthy as well as an unhealthy practice which ought to be abandoned.

When water is too muddy to be applied directly to filters the obvious treatment is to remove as much of the solid particles as possible, by sedimentation; that is, sedimentation basins should be considered as essential parts of filtration plants for the treatment of muddy water. The effect of sedimentation is to remove the larger particles in the raw water, which occurs in a relatively short period; the improvement effected after the first twenty-four hours being comparatively slight.

The cost of filtration, although considerable, is not so great as to put it beyond our reach. Hazen states that it may be roughly estimated that the cost of filtration with all necessary interest and sinking funds will add about 10 per cent to the average cost of water as at present supplied.

It may be confidently expected that when the facts are better understood and realized by the American public we shall abandon the present unhealthy habit of drinking polluted river and lake waters, which has been characterized as a national disgrace and a menace to our citizens.

The main point is that disease germs shall not be present in our drinking water. If they can be kept out in the first place at a reasonable expense, that is the thing to do; if they cannot be kept out, we must take them out afterwards; and this filtration (when properly carried out) will do thoroughly and at a reasonable expense.

Dr. Hutchinson: These two papers are now open for discussion.

Mr. Sublette (Minneapolis): Sewage disposal and water supplies are interesting problems. Theoretically we need an outline of some general method for sewage disposal, but practically we must use the best means at hand. With regard to the purification of sewage to prevent the pollution of water. This is a subject which scientists have not yet solved. The pollution of the Illinois river by sewage from Chicago is evident. Whether there is any less sewage by the time it gets to St. Louis is not yet settled. We know there is more water and more sewage on the way, but I am of the opinion that the purification of the sewage is not obtained by simply mixing it with water.

With regard to the water supply in Minnesota, Prof. Flather has given an outline, but this involves considerable expense to the isolated district. It costs money to make analyses of water. I think it incumbent upon the physicians to outline some method by which it can be determined whether a water supply is pure or not. I am of the opinion that sewage poured into rivers in any quantity, however small, affects the water supply. As to sewage disposal generally, I think the septic tank idea is all right in isolated districts. It is equally feasible to the farmer and small builder.

With regard to the city of Minneapolis, the treatment of sewage disposal is a problem that we have on hand there. I would be glad to have the chair listen to some facts which I have asked my assistant, Mr. Ilstrum, to collect.

Mr. Carl Ilstrum: Mr. President, I had intended to make some remarks relative to sewage disposal, but as the subject was so well presented in the paper of Mr. Wilson, and feeling that a more technical discussion of the matter would hardly be proper at this time, I shall confine myself to a few remarks touching a side of the ques-

tion which I think this body will find within its sphere of proper and useful work.

I believe the matter of sewage disposal is as important to this sanitary conference as the water supply of our communities, for the reason that individual communities are liable to look at the matter of sewage disposal entirely from the constricted standpoint of their own needs regardless of possible nuisance and consequent expenses thrown on some other communities. To procure proper sanitary results with all interests equally guarded, this matter ought to be handled on the broad plan of the whole state's interest, with state supervision under the direction of an expert commission of sanitarians. Of course, to a limited extent, such power rests with the present State Board of Health, but new power and scope would be needed before said board will be in a position to step in and regulate each plan of sewage disposal to the general interest of all concerned.

To insure sewage construction and method of sewage disposal which will be permanently satisfactory to everybody interested, all plans and designs should be submitted to and approved by some competent state authority, whose business would be to vigilantly watch that everything be done to obtain the best results for the least amount of money. Authority should also be given said board to compel any community already provided with sewerage systems to modify and change the same so as to minimize any nuisance which might exist as a consequence of faulty plans or incompetent management. Such a state authority with its sanitary experts would be of inestimable value to each and every community, insuring its plans and designs being up-to-date, obviating a good deal of future litigations, as well as possible heavy expenses incurred in changing faulty plans, which would have been avoided if properly built at first.

There may not be a great crying need of such a state control as yet, but our state is fast settling up, and cities, towns, factories and rural conditions are growing fast, and the sad and costly experience in other older settlements should awake in us a desire to anticipate the future and its needs, and it would seem only a part of ordinary good sense to weigh this matter seriously and take some steps as soon as possible to study the best ways of meeting conditions which are fast approaching, and certainly will in time call for some action along the lines suggested.

I think this body should take this matter up for discussion, and, if found advisable, some plan should be formulated by which it

could be brought in proper shape before our state legislature for their further careful consideration and action.

Prof. Eddy, of the State University: Mr. Chairman and Gentlemen: This is a most timely and excellent suggestion to which we have just listened. The State Board of Health ought to be clothed with authority by law to prevent the pollution of rivers and lakes by sewage, and it should have power to prevent the unsuitable sources of water supply. Mere advisory powers are quite insufficient to protect public health. Our course as a state must in the near future be like that of Massachusetts, where it was found necessary to empower the Board of Health to make a detailed study of all sources of water supply in the state, and investigate all complaints of pollution. No public water supply, no drainage into streams and no system of sewers can be constructed in Massachusetts until the plans have been approved by the board. Expert advice may be obtained gratis from this board by any community with regard to feasible and unobjectionable plans for any and all such improvements by any community contemplating their introduction. Massachusetts has inaugurated a wise and liberal policy in this particular which we could copy with very great advantage. When, with the lapse of time, the population becomes more dense in Minnesota, and the various towns and villages each introduce their own system of water supply, the question of the disposal of the vast volume of sewage thereby produced will become so serious and so menacing to the public that nothing short of systematized legal control can protect public health and restrain one community from polluting the water supply of other communities. Since cases of infringement on the natural right every community has to unpolluted water must occur with increasing rapidity hereafter, and since this subject of the legal control of pollution will become of increasing importance, I take this opportunity to emphasize two points: First, that it is unjustifiable, and a peril to public health, to allow sewage to flow into any stream used as source of public or domestic water supply, no matter how far that source may be below the outflow of the sewage; and furthermore, that the water running in any stream in its natural, unpolluted state is an unsuitable source of domestic supply until it has been properly treated. These are two statements which I think are now so firmly established by sanitary authorities that they are indisputable, and may be regarded as axioms. Just what treatment raw water may need in order to render it fit for domestic purposes is a question for ex-

pert investigation in each particular case. It is not, however, the subject of water supply—a subject which has been so well treated by Prof. Flather—which I desire to consider for a few moments, but rather the subject of sewage disposal, because this seems to me a very vital question and one which has not been so impressed upon the public as that of a suitable and healthful water supply; though, to be sure, these two subjects dovetail into one another in such a manner as to render it almost impossible to consider them separately.

The general subject of sewage disposal may be considered with reference to large towns and cities, and with reference to single institutions or separate houses, such as isolated dwellings and farm houses. And I may say in passing, that this is a subject which has been discussed in a semi-popular yet very admirable manner by Col. Waring in a book entitled "Modern Sewage Disposal." You will doubtless recall the fact that it was Col. Waring who reformed the street cleaning department of New York City a few years since, and that he lost his life in consequence of his effort to complete a sanitary sewage of Havana for the United States Government, with a view of eradicating the unsanitary conditions which had rendered that city a focus of infection for yellow fever. Col. Waring explains in his book with great clearness what means must be taken to make a suitable and sanitary disposal of the sewage flowing from country homes. The basis of such disposal is its treatment by the method which has already been referred to by the author of the paper before us, either as intermittant filtration, or as broad irrigation. These two forms of sewage disposal depend ultimately upon biological processes which are identical, but which differ radically from those occurring in the ancient disposal of sewage in cess-pools or similar receptacles.

When sewage is made to flow upon land or prepared beds of sand where the under-drainage, at a depth of five or six feet, is sufficient to carry away the effluent and keep the level of the ground water down to the level of the drains, and the flow occurs only at intervals of half a day or more, the oxygen of the air gains access so fully to the soil which is periodically wetted by the sewage that the organic contents of the sewage are fully destroyed and changed into harmless inorganic and mineral substances, and in the course of these changes there is nothing occurring in any way dangerous to health. When, however, sewage enters a pool, or is kept submerged for any length of time without free and intimate contact

with the oxygen of the air, putrefaction takes place, and changes occur in the organic substances of the sewage which are not only exceedingly offensive to the senses but dangerous to health. By such means the soil around cess-pools and sink drains is poisoned, and these contaminations are likely to soak through the ground to the general body of ground water and so poison all the wells of the vicinity. Col. Waring proposes that the sewage from single houses should first be collected in a tank large enough to hold the flow for a half a day or so. When the tank becomes filled let it then be automatically discharged through a siphon into channels which will allow it to flow over a considerable area of land, or else into porous tiles a few inches under the surface of the ground, where the soil is sufficiently open to admit the air pretty freely. This intermittent discharge prevents the soil from becoming permanently soaked, and gives an opportunity for the bacteria which exist in immense numbers in the sewage to nitrify and mineralize the organic contents of the sewage. Although the organic matter of sewage is not usually more than one or two thousandths part by weight of the sewage, yet the bacterial content is so numerous that there are frequently more than a million bacteria in every thimbleful of it. Sewage in its fresh condition is simply dirty water, and is entirely inoffensive before putrefaction sets in, and if it be suddenly discharged in quantity so that it will spread far before the movement ceases, and if, furthermore, this discharge takes place at infrequent intervals so that the same hours elapse between the doses which are applied to the soil, the bacteria will meanwhile completely dispose of all the refuse and render the effluent clear and wholesome, and fit to enter running streams without polluting them. The sewage from the city of Paris in France is disposed of in this manner upon sewage farms a little outside the city. There is nothing objectionable to the eye or to the nose upon these farms. There is no nuisance created by the sewage, and the water which comes from the drains of the farms is used as a source of drinking water by the people who live upon these farms. It is better than ordinary well water. It contains somewhat more of certain nitrates, chlorides and other mineral constituents than the waters we ordinarily use for drinking, but there is nothing in this water harmful to the human system, and the effluent from these drains, or coming from other drains where complete bacteriological purification of water has occurred, is entirely unobjectionable and such effluent does not contaminate the streams it enters. The bacterio-

logical processes of which I have just been speaking are in their nature the same as those which occur in slow sand filtration of water supplies, but with this difference: In slow sand filtration the entire supply of oxygen is derived from the air which is dissolved in the water; and since that is very limited in amount it is not possible to purify by slow sand filtration any water which contains more than an exceedingly minute amount of organic matter. Any attempt to purify by continuous slow sand filters waters which are seriously contaminated by the organic wastes contained in sewage necessarily fails for lack of sufficient oxygen. Such waters need the larger supply of oxygen which is furnished by intermittent filtration, where by occasionally draining the filter bed sufficient oxygen is supplied.

Some of the experiments made at Lawrence, Massachusetts, by the State Board of Health illustrate those processes in a very striking way. It was found, for example, that sewage was perfectly purified by being passed in a thin film over stones or coarse gravel, and that the ability of such a filter to dispose of sewage gradually increased with the lapse of time, and the constant multiplication in the number of colonies of bacteria existing upon the surfaces of these stones. In other experiments chloroform was used with the effect of at once stopping bacterial activity and preventing all purification.

We may say, therefore, that we have reached a point where we understand the processes involved in the purification of sewage. It is possible, then, to frame laws intelligently which shall guard the public health in these particulars. We should not, hereafter, permit sewage to enter the streams of the state because, as just stated by City Engineer Sublette, it has not been proven that rivers purify themselves by any natural process. Sewage in a stream settles to the bottom, and this, so far as we know, merely permits an increased growth and multiplication of sewage bacteria by the current whenever any great freshet flushes the bed of the stream.

When wise and sufficient enactments shall have been put upon our statute books to prevent the pollution of our water courses and lakes, it should at the same time be made the duty of our State Board of Health to attend to the enforcement of these laws, and compel reluctant or heedless communities to obey the just requirements of enlightened sanitary regulations.

Prof. Hays (State Experiment Station): I believe that the State Board of Health, in connection with the public institutions,

has an oppotrunity to do considerable experimenting that will be helpful, not only for those institutions but for the cities of the state.

In Reading, England, I found them spreading sewage over large surfaces and irrigating farm lands. We have a little sewage plant at the Experiment Station, and we are getting ready for some experiments, and I am much interested in the suggestions that have been made to-day. It is not easy to meet all the conditions. In winter the ground is frozen, and caring for the water in winter seems to be our most difficult problem. I believe in many villages in the state the sewage could be taken out without much expense and spread on the land. We should not, however, get the notion that this water used for irrigation will so increase crops as to cover a large part of the expense of caring for the sewage. The sewage will increase the crops, but land in this country is cheap, and our crops are raised so cheaply that only a small part of the expense will come back. I believe the time is coming when irrigation will be common in Minnesota. Experiments in the disposal of sewage will encourage the use in a practical way of some of our abundant water available for irrigation.

Mr. Carel: Prof. Flather spoke about the chemical analysis of water, and as I am interested in that subject, I would like to say a few words on it. What do you mean by chemical analysis of water? What does the chemist mean when he makes a statement like this: chemical analysis evidences the presence of organic infiltration? Does it mean if we drink the water so con demned we shall become sick from the typhoid fever? No, not necessarily so; but it does mean this: the chemist tells us that there is direct communication between the village well and Mr. Jones' barn yard, between the village ice supply and some upstream sewer, between our own well and our neighbor's hole in the ground outhouse, between the drinking water we place before our children and some filthy cess-pool reeking with noxious organic matter. That is what the chemist tells us and that is all. It is not his function to go farther. But in addition to all this, you as physicians add your knowledge of the pernicious action of certain bacteria, certain vermes, certain fungi, which never occur in pure water but which may find a pleasant habitat in polluted waters. It is remarkable, however, to notice that even where waters have been condemned the wells are often continued in use. People persist in using the water, and the health officer does not

find it advisable to insist that they should not, consequently said water is used after condemnation by chemical analysis. Now, these people drinking water of this nature do not necessarily suffer a premature death. They may live a long life, but that does not necessarily prove to us that we should place filthy water upon our table for drinking purposes, even if we seem to escape the clutch of disease. The probability of contamination of any given water depends largely upon the nature of the supply, as well as upon its environment. Let us consider first that class of waters which furnishes the greatest percentage of polluted supply,—the dug well. I would like to give you an instance. In the southwestern part of this state there is a little valley with a small creek or river running through it, and a village nestled in it. The soil and the sub-soil are sand and gravel. This sand and gravel is in one place dug into and the superstructure of an outhouse built over it, and a little further on a well is dug and a pump placed over it, again an outhouse and again a pump till we have many outhouse vaults, and many shallow dug wells, all in the same water bearing stratum. We took 16 samples of water here, and the 16 samples were condemned. The village well in this particular instance was situated some distance away from the main portion of the town, across the river. It also was a dug well, 14 or 15 feet deep in sand and gravel. It was located in a large natural park with acres of room, but an outhouse was placed about 50 feet away from this well for the accommodation of the men in the waterworks and the strolling public. There was absolutely no reason why this should be placed so near the well. We advised the local board of health on the subject, told them the well was infected by the closet; yet there it remained for two years afterward.

Another example I would like to mention: From one of the Missabe Range towns (I do not mention names because it would be unfair) 18 samples of water of dug wells were sent in to the laboratory, and of these dug wells 17 were condemned, and among the people who drank of these 17 or 18 wells 47 had typhoid fever.

Those are but two examples of dug well pollution in Minnesota. If I should stop to tell you of all similar instances we have met with in this state, the list would be very long: but these two are sufficient. You understand for yourself the necessity of looking after such waters. Those are the wells which should receive the first attention. You have them in every village of the state and wherever they are you may make up your mind that they are polluted to the extent of at least 90 per cent. This is borne out by

the facts. We have personally made many examinations of dug wells, and our records form the basis of my statement.

Now there is another kind of well closely related to the dug well, and referred to by Prof. Flather under the name of bored well. I an sorry to say that I disagree with his statement that this particular kind of well generally furnishes good water. As a part of our state water survey we have taken samples of bored wells and taken them with care, and with due reference to surroundings. Our endeavor was to secure typical specimens of natural water. This was however very difficult on account of the ever present barn and its accompaniments. Under the best conditions over 50 per cent of our bored well samples were bad: and why?

Some of the wells pass through sand and gravel. This class is but little better than the dug affair. Some wells, on the other hand, are bored through many feet of clay. How can the outhouse infiltration reach such water? In two ways: (1) by attenuation of the clay deposit, which may give us many feet at the point where the well pipe passes and very little or no clay at all where the outhouse vault is dug. (2) clay often has little seams of sand or gravel running through it, and these will carry pollution like a pipe. This second method is the cause of much bored well pollution.

I might add a third cause of bored well pollution and that is the possibility of surface water passing down outside the pipe and then getting into the water stratum below.

With reference to deep wells: they usually furnish excellent water, but not always. You will see in some text books that a deep well is always good water. This is not true. The deep well may go through only the clay. If it does we have the same proposition as in the case of ordinary bored well. And again the deep well may pass through stratifications of rock. Where the rock strata are intact and not seamed with cracks, flaws, dykes, etc. they furnish excellent protection against pollution. Sometimes, however, faulty rock structure will permit the infiltration of surface water and the supply becomes contaminated.

As a rule the deep well may be taken as good water; however, bear in mind these exceptions. So much for wells.

Springs: They may furnish a surface, a subsoil, or an artesian water. A great many of our springs are such artesian water and they are always good. If at a distance from habitations the surface and subsoil springs are fully as good and remain so until man or his domestic animals spoil them.

A favorite municipal water supply is the lake. Now the average Minnesota lake is very beautiful water, but please do not confound mud-holes with lakes. In a certain small town in this state, ice was being cut from a certain "lake" into which the sewage of the village flowed. There were 140 cases of typhoid fever in this village, and why? Because their ice supply was taken from that little mud hole into which sewage ran. A clean, fairly deep, lake of decent size, will furnish a desirable quality of water for municipal use, but said lake must be kept clean, and no offensive matter of any kind allowed to go into it.

The question of river pollution is one which it is hardly necessary for me to speak of. The average river in an inhabited country is but little better than an open sewer. It may originally bear beautiful waters from clear, bubbling springs, starting away back in the green forest; but it soon comes to the barn yard, the slaughter house, over-hanging outhouses, village sewers, etc. As health officers, these facts are so well known to you that any amplification on my part were useless.

I have thus far roughly indicated the chief sources and causes of water pollution.

But if we suspect a water, the next question is, what are we going to do about it? I notice the engineer of Minneapolis said it would be very expensive for outlying districts to secure a chemical analysis. It is the function of the State Board of Health to offer such analysis free of charge. Any local health officer in any city, town, village or hamlet of the State of Minnesota, has the privilege of sending in samples of water for examination and there is absolutely no cost to him for the analysis. At the present time the matter of expressage is charged to him. At his request we send to him a sample bottle. There are direction for collection of water upon the bottle. We also send a history blank upon which he tells us what he knows about the kind of water he is sending and its possible contamination. An opinion is given upon the sanitary analysis of that water and returned to him. There the work stops. Whether or not the well is closed no body knows except the health officer and the people of the town. We may send, and have sent, statements that the water supplying this or that village in Minnesota was polluted and it had gone to the hands of the health officer and stopped there. There seems to be at present no active power to procure the closing of these wells except through the local health officer. It would seem that there might be some method by which a little mandatory authority could be exercised by which

when a village puts in a new supply of water it should be subjected to the opinion of some one having authority. The water should be examined before it is distributed to the people. It would seem highly advisable that waters in use in the state should be so inspected and if condemned, the use of said waters should be stopped and a good fresh supply secured. The State of Minnesota is supplied with a great abundance and variety of excellent waters.

Keep pollution away and put your well down almost anywhere, to any convenient depth, and the result will be good water, from the sanitary point of view. The contamination of our water supplies is due either to ignorance, or carelessness, and can be remedied only by instruction and legislation. It is thus that we can secure for the people of Minnesota that pure water which God intended for them.

Dr. Norred: In one of my families in Minneapolis I attributed the cause of sickness to the water and began questioning them a little and the gentleman assured me that the well was a driven well through rock and he would certainly feel badly to know that that well was not all right. I took a specimen of the water and I satisfied myself that there was something wrong with it, and I turned it over to Dr. Drew for examination: Although it was a driven well, 95 feet deep, Dr. Drew's written instruction was that "if you can find a first class reasonably good sewer where you can get water you had better use it and let that well alone."

Mr. Tighe: I would like to ask the state chemist, how large a proportion of the waters that have been submitted to him for examination have passed muster and been approved?

Mr. Carel: Do you include only the waters sent us or those collected by ourselves as well?

Mr Tighe: Include those which have been sent in.

Mr. Carel; The percentage would be small for this reason: the waters sent in are usually waters which have been suspected by the health officer and in many cases consist of wells varying from the depth of a barrel to possibly thirty or forty feet in sand or sand and clay, with an environment of outhouses, cess-pools, barns, etc. Such waters never pass chemical inspection and they increase very largely the percentage of condemned wells. I cannot tell you without reference to our record of analysis anything approximate, but I should think that not over twenty per cent of the waters sent in have passed.

Mr. Tighe: Then I would like to ask, whether you accept as facts the statements of the local officer as to the surrounding conditions?

Mr. Carel: Whenever it is possible and whenever funds and time are available we prefer to take samples ourselves. When, however, we send a blank to the health officer inquiring the nature of the water and the facts as to environment, we take his written statement as the truth not supposing that he would falsify. In case he has not the knowledge he says so. The health officer can usually be relied upon to give all the information he has. At the present time it is seldom possible to take the samples ourselves, especially in the winter. because there is only one man engaged in the work and very little money is available.

Dr. Adams of Rochester, Minn.: Mr. Chairman, I have been interested in our state chemist's discussion, and recall with pleasure a visit with him in the city I represent. A large difference exists between our ability to furnish pure water for drinking purposes and a pure ice supply from the natural sources at our command, and keep it pure, and the ideal which he has presented to us. Only one source in my opinion will furnish pure water and ice supplies to cities. Ice derived from water previously heated to destroy organic matter and condensed by ice machines is practical and can be furnished at a reasonable cost. If I am to submit samples from a running stream I will choose a time when the stream is in a condition that ice forms upon its surface; not when its bank are overflowed, for I am well aware that it will be full of products indicating excess of arganic matter as nitrates, etc. I know it would be condemned. In our city a company have purchased what is practically a mud pond and exploit it as the only source of pure ice supply by quoting analysis made by the state chemist of the river when in high water with over-flowing banks.

I cannot discriminate between two questionable sources, but will be pleased to favor a true ideal ice supply. The attempt to emphasize laboratory reports of water analysis lead many to choose beer as a substitute, looking upon all water as contaminated and unhealthy. I cannot recommend this practice for I would soon be in collision with the Christian Temperance Union, and other temperance workers. I do not use beer myself nor do I wish to commend it to others.

When our state chemist is commissioned to inspect water supplies of a city he should in my opinion collect his samples without fear or favor, make his own analysis and condemn or approve as his analysis justify him in doing. The state should bear his expenses. I cannot understand that he has the right to condemn others for not desiring to do what he is paid to do, in reports he may see fit

to make. I will be pleased to co-operate with the state chemist in an effort to attain ideal ice and water supplies from natural sources, but I prefer that he take the initiative, use his state vested rights and I will help him in every step of the way. I know, however, no one will be more troubled than he will should he attempt the plan.

The President: This discussion is very interesting but the time is passing and we have to remember that there in an evening session. I think we will have to ask Mr. Wilson and Prof. Flather to close the discussion.

Mr. Wilson: I have been very much interested in hearing the different views expressed on water supplies and sewage, or methods, you might say, of getting water and getting rid of it. It occurs to me that there are three points where practical advantages can be obtained for the citizens of the state through action of your members. In the first place, the average individual pays a great deal of attention to the statements of his family physician, and the advice which the physician of a community gives will go a very long way towards procuring better water supplies and better sewage disposal.

The second point is that the investigations of the Massachusetts State Board of Health are almost unequaled in regard to questions of water supply and sewage disposal. Our State Board of Health has been following along the same lines, making a survey of the state waters, determining the conditions of the water supplies and other matters. The State Board of Health of Massachusetts, and also in several other states, whenever a town in the state proposes a water system, or a sewage disposal scheme, advises in regard to it and, if I am not mistaken, it is not legal for works to be built until the town has obtained the approval of the State Board. This is a subject that I think is entirely practical for the Board of Health of Minnesota to take up and carry out.

The third point is that the State of Minnesota has certain state institutions where the water supply and drainage is under state authorities, and, if I am not mistaken, under the State Board of Health.

The subject of filtration and sewage disposal can be studied at a number of state institutions at a small expense, and very valuable results can be obtained. At one of these institutions there are already appliances so that you can obtain very valuable facts regarding septic tanks. At another state institution it is planned to complete filter beds where the question of irrigation and sewage filtra-

tion can be studied. The State Agricultural School is already looking toward doing something along this line. But encouragement from members of this body and the State Board of Health will help a great deal. In some towns there is really nothing else for them to do but make application to the State Board of Health and wait until some investigations have been made by the state authorities.

These are the three ways in which this association can be of particular benefit to the citizens of the state.

Prof. Flather: Some of the gentlemen have raised the question of expense in making these investigations. Mr. Carel has answered this by saying that the State Board of Health stands ready and willing to make such analyses. I think I am correct in stating that the Board of Health will make water analyses, and advise regarding same, free of expense, and also give advice regarding sewage and sewerage systems; at present this is not compulsory, and the Board of Health would prefer to have voluntary requests rather than make it compulsory by law as in other states.

I think Mr. Carel misinterpreted one of my statements, as he is under the impression that I said "all dug wells are safe." My statement was this: "In those localities where each householder has his own well, dug to a depth varying anywhere from eight to twenty feet, laid up with wooden curbing or frequently laid up with stones set dry, there is every opportunity of the water being polluted by local contamination. * * * It is sufficient to state that too great care cannot be exercised in these matters, and periodic analyses should be made to ascertain the present condition of the drinking water. A little additional expense in laying the walls of the well and in cementing them inside and out with a good coat of Portland cement plaster will generally prevent the inflow of impure surface waters. Driven or drilled wells with the outer casing of iron pipe sunk to some considerable distance below the surface will aid very materially in obtaining a pure water supply either for domestic or public purposes."

As Mr. Carel states, in open wells the percentage of wells which show contamination runs possibly as high as ninety per cent; while in bored or drilled wells there are not more than fifty per cent which show contamination. But we must bear in mind, in any case, that the samples thus analyzed have generally been sent in from sources which may be expected to be impure.

It was moved, seconded and carried that the morning session, January 15th, should begin at 9:30 o'clock.

The President: If there is nothing further we will adjourn until eight o'clock this evening.

Adjourned.

EVENING SESSION, JANUARY 14TH.

Dr. Hutchinson: I wish to state in opening this evening session that the State of Minnesota is exceptionally fortunate in having as its executive one who takes the deepest interest in all that pertains to the material welfare of the people, including sanitation. I take pleasure in calling on his excellency, Governor S. R. Van Sant.

Gov. S. R. Van Sant: Mr. Chairman, Ladies and Gentlemen: I received a notice that I was to give you an address of welcome tonight, and I want to state that you are as welcome as it is possible for me to find words to make you. And why should you not be? You are engaged in a splendid work; one that is especially necessary in cities.

They say that God made the country and man made the city. God's work is perfect, hence the country does not need sanitation to so great an extent as the city where people congregate in large bodies and where without sanitation we could not exist at all. In the country the rivers, streams, creeks, and the ravines carry off that which in the city must be carried off by means of sewers. The great river that flows past us is different now from what it was when I was a boy. It was looked upon as the great "Father of Waters." We should no more think of polluting our river water than of jumping into the lake to drown ourselves.

I am very sorry that I am not able to talk to you upon sanitation. You know more than I do about this subject. I am inclined to take the position of Senator Beveridge who, when called upon impromptu, absolutely refused, saying that he would not talk at a banquet, on a banquet, as he did not know one-twentieth as much about the subject as those who sat before him.

You are welcome, and are here for a splendid purpose. I am glad there is a State Board of Health that is interested in sanitation. Were it not that I have largely appointed the board I would say more in its praise. I hope that it will do its duty.

I want to say, ladies and gentlemen, that again you are welcome. I hope your deliberations at this meeting will result in great good. Spring time will soon come, and let me tell you that that

place is most desirable which has the best sanitary conditions and arrangements. I do not know whether Dr. Ohage is here, but I want to compliment him.

Just bear this in mind: you are doing the work of the Master. I congratulate you upon your splendid work and bid you God speed.

The President: The next item on the program is an address by Dr. Staples, of Winona,, the president of our State Board of Health. As he is not able to be present, this will be read by the Secretary.

Dr. Bracken then read the following:

STATE PREVENTIVE MEDICINE—ITS PROGRESS AND INFLUENCE.

BY FRANKLIN STAPLES, M. D., PRESIDENT OF THE MINNESOTA STATE BOARD OF HEALTH.

In presenting to the conference at this time a few thoughts on state preventive medicine, I desire to call especial attention to certain important results of the same, which are now seen to have been of an educational character, and, as such, to have had their part in aid of the great progress in sanitation now witnessed. In this the field of observation is now one of vast extent, and the review and brief mention here of facts and features must be more for illustration than otherwise—a small part for the great whole.

We can best understand and account for much that now appears in this, as in other departments of governmental service, by a glance at the history. The whole period of state medicine proper, in this country has been less than a half century. Time was required for its establishment and early advancement; but in the more recent years of its history the growth, both in its rapidity and magnitude, has been phenomenal. The beginning was in this way: The governor of the State of Massachusetts, by authority of an act of the legislature, in 1849 appointed a committee of three citizens to prepare a plan for a sanitary survey of the state. This was done with reference to further contemplated action—that of establishing a system of sanitary control. Such men as Lemuel Shattuck, Jehiel Abbot and Nathaniel P. Banks—later governor of the state—were made to constitute this committee. These men of the old Bay State, whose names and works have come to these later times for good, were known as having, for their time, advanc-

ed ideas of state sanitation and the advantages thereof. They were true representatives of a class, then not as large as now, whose minds were alive to the wants of the state and the nation in the great matter of the public health, and their good works were not wanting. There were, however, obstacles in the way of immediate procedure. General information was found wanting. The practical working of what was then sought for and what was in time to come, had not then taught its lessons in public health and economy—the ways and means thereof.

The First State Board.—Twenty years were allowed to pass after the initiatory work here noted, before the Massachusetts State Board of Health, the first in the country, was established and began its work. This was in 1869. What public provisions for sanitary work had been made before this time in any state, were of a temporary character, to meet special emergencies. Such had been the case at one time when the city of New Orleans was protected by quarantine against an invasion of yellow fever. This and a few other examples may perhaps be regarded as early indications of the coming of state medicine, and as having had something to do in preparing the way. The Massachusetts board was the first in the country so established and equipped as to be able to do such general good work, as to secure for itself a high and permanent place in the public service. As now seen, this early service was useful in an important way, by furnishing object lessons in practical sanitation to other states and communities at home and abroad.

At the beginning the province of public sanitation was more limited than at present. Developments and extensions of late years have created great departments in the work, and the higher and wider practical knowledge demanded has come with the advances of modern science.

After this beginning in Massachusetts, eight years were required to found the next ten boards in as many states—the State of Minnesota being one of the number. The Minnesota board came into existence in 1872. About that time the extension of organized and authorized means of preventive medicine, principally in the passage of sanitary laws and the establishment of executive boards, became more rapid and complete—teachings of the past were effective.

*The Outlook of the Centennial Year,*1876.—We are told the story of state medicine by good authority, as seen at the beginning of our nation's second century. Dr. Henry I. Bowditch, President of the State Board of Health of Massachusetts, was called to deliver the address on State Preventive Medicine before the international

medical congress assembled in Philadelphia in 1876. His words will not be forgotten. He said: "In its medical and social ideas the past century easily divides itself into three unequal periods, viz. I—From 1776 to 1832, the era of theory and dogmatism. II—From 1832 to 1869, that of strict observation and of bold—often reckless skepticism. III—From 1869 to 1876, which is destined to continue and progress while the nation itself lives, the noblest and most beneficent of all, viz., that in which the profession, joining heartily with the laity and aided by the material and intellectual resources of great states, will study to unravel the primal causes of all disease with the object of preventing it. It is the era of state preventive medicine." Since these words were spoken to the congress of the nations assembled in this country, a quarter of a century has passed. What was then prophecy is now in history. It has been our happy privilege to witness the fulfillment. Two conditions made, in these words, to characterize the present period—that of preventive medicine—deserves not only our thoughtful attention, but our admiration:—first, the unity of laity and profession in the work of preventing disease;—of elevating the standard of public health; and, second, what is contained in the words, "will study to unravel the primal causes of disease, with the object of preventing it." Could the sanitarian of 1876, in his vision of the great future, have had in view the essentials of preventive medicine in its present estate? Was the part of state laboratory work in the diagnosis and in the study of the pathology especially of infectious diseases, and all that has come from the knowledge acquired by these means, then even anticipated?

Whether the State or the Nation?—It has been a question whether the sanitary control of a country is better secured when all power is vested in the national government, or in the different states by and for themselves. The former plan holds, in the main, in Great Britain, France and Germany. The United States of America is composed of a federation of states and occupies so much of the North American continent, as to render the different states subject to different conditions and to different sanitary requirements. Besides, recent additional posessions have extended the domain to other lands and climates, and have added to the natural differences and wants. Different local authorities are able to understand their especial needs and how to meet them, under the general direction. Different state boards, together with their important general work, have had much to do in making certain specialties aid in the general advancement. The board of Michigan, by its able secretary, has led the way in teaching the world the importance of vital statistics; how the same could be made instructive in the mat-

ter of directing the use of preventive means. The board of the State of Illinois put in motion the reform which resulted in elevating the standard of medical education. This work and power of control has for some time been given in the states to a special department of state government; but the state board of health of Illinois, under the leadership of the late Dr. John Roche has the credit of the initiatory work. These are given as examples.

The great State of Minnesota is largely an agricultural and stock-raising state. There is always more or less disease among animals, and sometimes special prevalences have occurred which have required authoritative investigation and management. It is necessary for the state board to make its veterinary department an important one. Owing to increase in the industry, this has been especially the case in the last few years. Stock raisers, shippers, and purchasers require, and reasonably ask, the aid of the State Health Department. Fortunately, of late years the study of the nature of the infectious diseases of animals, as well as of man, has been greatly aided by the efficient work of the laboratory department. In the sanitary point of view, diseases of animals are important because of the communicability of many of them to man, and, as suggested before, are important in seriously affecting a legitimate business. A laboratory department has now a prominent place in the sanitary boards of many states. In these the government has been able to have its part in the work of pure science, and in return has enjoyed the practical benefits of this work. We know more than formerly of the kind of quarantine required in specific infectious diseases, the kinds of prevention, and the meaning of immunity.

In addition to and greatly in aid of what is done in and by the states, is the work done by certain national departments of the public service. These are, first, the Marine Hospital Service, so called because of its former principal function in the government service; the War Department and the National Agricultural Department,—this especially through its Bureau of Animal Industry. The heads and chief officers of these divisions of the government are informed, and are largely experts in practical lines of sanitary science. Original investigations, reports and publications by each of these departments have become important sources of practical information to the general public, as well as to the special sanitarian.

Our conclusion on the question proposed is this: The present general outlook clearly shows that no material change in the state

or government functions would be likely to cause an improvement in the country's sanitary work.

Lessons from Inspection Service.—An essential part of local sanitary work is the authoritative inspection of persons and premises. The inspector enters the premises of a household where, perhaps, some form of disease has been reported to exist. He observes a defect, and says at once: "This fermenting, unsanitary pool of kitchen slops by the side of the back door must be removed, and the place put in sanitary condition." Further, "I will go into the basement and see if any decaying vegetables are there. I will examine the house ventilation, will measure the distance from the well to the privy vault, and will take some water for examination." These and other procedures of the officer, and the subsequent report to the owner and occupants, proves not only to be a cause of sanitary improvement on the premises but an effective means of education in the matter of disease cause and prevention. Such examinations and directions are made and given by health authorities for school and other public buildings and premises, as well as for private homes. The service intelligently and faithfully done tends to educate the public mind in matters pertaining to the preservation of life, and the advantages of purity in life surroundings.

Schools and Literature.—The literature of sanitation throughout the country has come to be great in quantity and excellent in quality. The American Public Health Association publishes its proceedings, reports, and papers annually, and these reports are furnished to all its members. The records of the National Conference of State Boards of Health are also published annually. The annual reports of state boards contain a large amount of literature, not only of local but of general importance. There are frequent bulletins containing special reports issued by all state boards. The sanitary journal literature has assumed great importance. Moreover, for the general educational advancement, the time is now when we have departments of sanitary science in many of our colleges equipped for instruction in this department of study and practical work.

We are living in an era of public sanitation. It has its large place in the great governments of the world. The outlook indicates that it will continue and progress. The parts, however small, that shall be ours in the work, may have their places in aid of the advancement to come.

The President: We are sorry that Mrs. Condé Hamlin is not able to be with us this evening to present the subject announced on

the program, "The Influence of Women upon Sanitation," for this is an important and far-reaching topic.

We will proceed to the various papers on tuberculosis and their discussion.

TUBERCULOSIS.

BY CHAS. LYMAN GREENE, M. D., CLINICAL PROFESSOR OF MEDICINE IN THE UNIVERSITY OF MINNESOTA, ST. PAUL.

The civilization of any country is best measured by its sanitary laws. The greatest and most beneficent warfare ever waged in the history of the world is that against contagious diseases undertaken by the physicians of all countries in the face of a determined opposition based upon ignorance, apathy, carelessness or a selfish disregard of others.

The moment that any disease is proven contagious or infectious we know that it may be successfully attacked. Smallpox, once the greatest scourge of Europe, has been nearly eliminated, despite the frantic efforts of misguided fanatics to spread and propagate it. The plague, which in past centuries decimated Europe and killed during a period of sixty years or one-quarter of its population, cannot now obtain a foothold in any civilized land. As a result the average life time of man has steadily increased and none can estimate the volume of happiness and comfort which has replaced the grief and suffering of former years.

All this time tuberculosis, under the name of scrofula or consumption, has been killing its millions annually without serious hindrance. It would seem as if the people of all countries regarded it as a necessary evil or a chastisement visited by the Almighty upon His people.

It is high time that every person in the civilized world was made to understand and appreciate the fact that consumption is a preventable disease. This fact has been established beyond all question by the investigations of Koch, who isolated the germ, grew it in pure culture and found that when introduced into the tissues of a healthy animal it produced tuberculosis and might be recovered from the diseased tissues and grown again in pure culture, thus completing a perfect demonstration that means the ultimate saving of millions of lives and the eradication of one of the most horrible diseases that has ever afflicted the human race. How many realize that of the present population of the United

States at least ten millions are doomed to die short of their expectancy and for the most part in youth and early manhood from tuberculosis.

Human nature is full of strange inconsistencies. She holds up her hands in horror when a steamship is lost at sea or a railway disaster sends a few score of people to their death.

The whole world is staggered by the price that South Africa demands of England, yet it has involved only a paltry 17,000 lives up to date. The losses in the Spanish-American war which has brought sorrow to so many homes were but a bagatelle, a mere 2,565 men, whereas, at least 150,000 die each year in the United States alone from tuberculosis, and no one but the physician seems to be greatly interested. The men who die in the service of their country, fighting to avenge her wrongs or maintain her rights, are honored in victory and in death. If killed upon the battlefield their end comes swiftly, usually painlessly and with mercy. If in the hospital the knowledge of duty done, the thrill and spur of patriotism and the plaudits of their countrymen uplift and strengthen them. Not so with the victim of tuberculosis, who is doomed to weeks, months or years of suffering, obscure, patient, unrewarded struggle against the inevitable.

If war be wicked in that it costs precious lives and weakens whole nations, what shall we say of tuberculosis, which continues its ravages in all years and in every season, sparing neither the gray beard nor the little child but seeming rather to select the most beautiful and attractive for a terrible death, preceded by years of suffering?

If ignorance of the laws be no excuse for the commission of crime shall we not hold guilty of constructive murder the legislators who refuse to pass good sanitary laws, and the officers who fail to enforce such as are passed, and indeed the mothers and fathers who cannot be aroused to an active interest in a campaign against the destroyer of their children.

Insanitation is a survival of primitive barbarism. Infectious diseases should not exist in any civilized country and could not if our citizens, our men and women alike, would give to the problem of disease prevention even a fractional part of the interest so readily devoted to trivial things.

What does it mean when we say that tuberculosis kills 150,000 people annually? It means sorrow, suffering, loss of population and of productiveness; it is equivalent to a withdrawal of $750,000,000 capital, for each human life has a definite value in the world

of commerce. It must always be remembered that where one dies many are sick, and that in every year not less than one million of our people are walking in the shadow of an uplifted sword.

The advance in modern medicine makes possible an early detection of this disease in the individual, and however fatal it may be in the advanced cases, in its incipiency a large percentage may be entirely cured.

The way to wipe it out of existence, however, is to prevent or forestall its appearance, rather than to undertake its cure after it has become established.

Every physician must feel a thrill of pride when he realizes that every advance made in the direction of diagnosis and of cure, every step in the march already under way, which has saved thousands and thousands of lives, has been undertaken by the medical men who have worked against sentimentalism and selfish interests and shouted the truth into unheeding ears.

As a result of the campaign inaugurated in the city of New York by its efficient health officer the lives of thousands have been saved and the reduction in the mortality in fifteen years has been 35 per cent.

Dr. Biggs believes that in another five years 3,000 lives will be saved annually through these same simple measures.

It is first of all absolutely necessary that the public shall be convinced of the fact that this disease is preventable and they must then be instructed as to what measures are necessary in the way of protection. We no longer believe that tuberculosis is directly transmitted from mother to child.

The child of a tuberculosis mother is not tuberculous when born, but has inherited body tissues in which the germ, if introduced from without, finds a fallow soil. Inasmuch as we cannot allow children the privilege of choosing their parents our duty lies in protecting them from infection after birth. This can be done if the simplest sanitary laws are obeyed, but we cannot expect such a child to live unharmed in a close and vitiated atmosphere, in a room filled with germ-laden dust, nor can we expect it to withstand constant contact with the lips of a fond but ignorant consumptive mother. In an intelligent and properly instructed household there is practically no danger to the healthy even though several family members be infected.

The danger from dust is readily appreciated when one learns that in twenty-four hours from 300,000,000 to 400,000,000 living

germs are cast upon the outer world. Fortunately, these are of low vitality and low power of infection, and fresh air and sunlight may dilute or destroy them.

The first thing to be considered, therefore, is the effective destruction of all sputum. This is readily accomplished by the use of proper receptacles filled with antiseptic solutions and by the immersion in boiling water of all linen used by a consumptive person and likely to be contaminated. Another danger threatening the child arises from the use of infected meat and more often milk. The medical world believes that the great Koch blundered in making his famous declaration bringing into question the danger of infection through meat and milk, and even if it were true that this risk were very slight the idea of eating the flesh of tuberculous cattle or of drinking milk of infected cows is of itself abhorrent and justifies every measure so far undertaken to eliminate such products from our food supply.

It must not be forgotten that the consumptive, under present conditions, serves as a distributing point of infection, and that if as we know 2,000 of the citizens of our state die annually, at least 10,000 or 12,000 living centers of infection exist and serve to propagate and perpetuate the disease.

We need, therefore, to build sanatoria that the incipient cases among the poor may be treated, and hospitals for consumptives of the same class who are advanced in the disease and are a source of danger in their usual surroundings.

We waste too much time in searching for a cure for established and far advanced disease, and the hopefulness and credulity of the patient is reflected by the attitude of the medical profession, which leads them to hope against hope for a specific agent of cure.

At the present time a great discovery is announced which may revolutionize all our methods of treatment, but will probably fail to live up to the hopes of its discoverers.

As matters now stand the greater number of incipient cases can be arrested if seen *and recognized* early and if treatment can be carried on under proper climatic conditions and with a free hand.

Under present conditions the rich may hope, but the poor must despair, for all these things mean the expenditure of time and money to an extent impossible for the latter.

Marriage between consumptives or between the healthy person and the consumptive is a terrible mistake. Almost every person

has seen examples proving the truth of this statement. One investigator has reported that of thirty-nine wives married to consumptives, eighteen became affected and died of tuberculosis. Marriage to the tuberculous wife means a strong probability of death after the birth of her first child.

It will thus be seen that under the present conditions of ignorance or apathy the unfortunate victim of tuberculosis is a public and private menace. Are we to allow our citizens to be slaughtered by the hundreds of thousands in the future as in the past, or shall we bring to bear common sense backed by energy and create a public sentiment which will wipe out this destructive curse?

Some one has said that the battle against consumption must be fought by the general practitioner of medicine, but I say to you that the battle must be fought by the public itself.

The physicians have formulated for you the methods and channels of infection, have shown how it may be prevented, have secured the passage of many laws of great usefulness, and now it is time that you yourselves should awake to the necessities of the occasion.

1. You should demand a national board of health with a medical cabinet officer at its head.

2. You should disseminate information relating to the infectiousness of tuberculosis until every man or woman must know the truth.

3. You must insist upon the rigid enforcement of the laws against spitting in public conveyances or upon walks or roadways.

4. You should demand thorough and frequent disinfection of all sleeping cars, hotel apartments and public buildings.

5. You should insist upon the most rigid inspection of all meats used as food.

6. You should have enforced, with the utmost stringency, the laws relating to dairy inspection and the elimination of tuberculous cattle from dairy herds.

7. You should provide sanatoria and hospitals for the consumptive poor.

8. You should form societies having for their purpose the enforcement of all sanitary regulations and the dissemination of information along the lines suggested.

There is no doubt that if these simple measures were generally adopted we should in a single generation save for this country annually at least 50,000 lives and in a short time consumption would be as rare in this beautiful land as is the black death today.

THE SANATORIUM TREATMENT OF TUBERCULOSIS.

BY H. LONGSTREET TAYLOR, A. M. M. D., ST. PAUL, MINN.

Hippocrates recognized the curative properties of fresh air in the treatment of consumption. The same idea can be traced through the teachings of writers on medicine since the dark ages, but, although they appreciated the virtues of fresh air as shown by the recommendation that patients secure out of door employment or be sent to some salubrious portion of the country or the sea coast, or on long ocean voyages, yet the supreme importance of the fresh air and the best ways of getting the entire benefit from it, was not appreciated or practiced until Brehmer, the father of our modern aerotherapeutics in this disease, convinced that it could be used as a curative agent when combined with intelligent management of the case in every way, dietetic, hygienic and medicinal, had the courage to found the first sanatorium in which his ideas were employed in the practical care of consumption. How successfully he was able to demonstrate to the world the correctness of his theories, is conclusively shown by the complete victory of the sanatorium treament, less than fifty years after he opened the first institution for the care of the sufferers from this scourge of humanity.

The principles of the sanatorium treatment are simple and yet are very difficult to carry out at the patient's home. This is partially due to the necessity of the constant presence of a medical attendant to notice any shirking of the directions on the part of the patient and to see that no mistakes are made. The success or failure of the treatment depends on so many apparently trifling details that at home, away from any but occasional professional supervision, the deviations from the plan as carried out in institutions, which it seems almost impossible to control, are usually quite great enough to defeat the object aimed at. In my own personal experience the objections of the patient to sitting out for six or eight hours a day on the porch, have been impossible to overcome. Even such excuses as, "The neighbors would think I was crazy if I were to sit there for hours each day in cold weather, wrapped up like a mummy," or the simple declaration "That would drive me crazy," or "I would catch cold every day," etc., are made by intelligent patients and it is impossible except very occasionally to find any one who will conscientiously carry out the details of the treatment to the letter. If an intelligent patient

is willing to do exactly as told, and has a determination to get well, that will sustain him for months in a very irksome and necessarily lonely existence, then the open air plan can be successfully carried out at home. But in a sanatorium every one is going through with the same procedure. The older patients help the new arrivals by their example and encouragement; the fear of catching cold and of the dangers of night air are minimized by their assurances. The patient's every whim is not listened to by the medical or nursing staff, and he soon notices an improvement in his condition that helps him to keep on and endure whatever may be necessary. Hence it is that the best results can be obtained in an institution. Here the requisite number of hours must daily be passed in the open air, either properly protected on a porch or taking such walks as are allowed by the physician. The necessary rest is enforced in fever cases. The food is carefully prepared and is as carefully selected in order to meet the requirements of the case. The ventilation of the sleeping room is not left to the patients or their friends. Any irregularity or abnormal action of any of the functions or organs of the patients is at once met by the indicated therapeutic measures, although drugging is as much as possible excluded from the routine treatment. Rest, fresh air, and food, are the corners of the tripod upon which the success of these institutions has been built and upon their intelligent use must its future depend. In different institutions some particular line of treatment is often added to this hygienic and dietetic scheme, but the foundation is the same in all. The one condition is that nothing must be given which in any way interferes with the action of these cardinal points, more especially with the proper digestion and assimilation of food. One of the most important measures which is largely used in all sanatoria is the use of water, and no where has modern hydrotherapy received more attention or given better results.

Brehmer's institution at Göbersdorf, in Silicia, was necessarily only for those who were well able to pay for their care, and for many years such institutions as were built in different parts of Germany and Switzerland were only for the rich. The first sanatorium for the poorer classes was erected in this country and is still conducted by Dr. Trudeau at Saranac Lake in the Adirondacks. It was opened in 1885. It must not be forgotten, however, that England was the first country in which steps were taken to alleviate the sufferings of the poorer classes from consumption and noble charities were supported in and near London, even prior

to the founding of Brehmer's sanatorium. But those English institutions were hospitals for the care or poor consumptives, and they have undoubtedly contributed largely to the remarkable diminution of the death rate from consumption in that country by the segregation of many cases and the consequent restriction placed upon its spread, because these hospitals take in desperately sick individuals at the time when their presence in the crowded and unsanitary homes of the poor would be the most dangerous to their relatives and attendants. At the same time the general reform in sanitary matters and the strict enforcement of the laws in regard to the dwellings of the poorer classes throughout England must be given their full share of credit for the reduction of the death rate in England from tuberculosis during the last half century, of almost 50%. The sanatorium treatment of pulmonary tuberculosis was soon shown to be best suited to beginning cases and in these it has been so successful that the insurance companies in Germany, organized to fulfill the law requiring laborers to be insured against loss of time from sickness or injury, soon found that their greatest outlay came from the loss of time due to the great number of consumptives among their risks, and that it was to their financial interest to give those invalids the opportunity of a recovery which a residence in a sanatorium offered them. Hence it is that at the beginning of this year (1902) there are over forty of these institutions for the poorer classes scattered all over Germany (43 for the poor, 16 private institutions). They are situated near every large center of population and not only in the districts where the best climatic advantages are to be found. The results of the sanatorium treatment can best be thoroughly appreciated when the statistics collected by these insurance companies are carefully studied. The one condition that is unfortunate is that they restrict the time of treatment to three or four months, whereas very much better results are reported from private institutions among those patients whose stay has been prolonged to between six months, and a year or even longer. But notwithstanding this one unfortunate condition, the following results are very satisfactory.

The best report of the kind is contained in an article by Dr. Reiche of Hamburg, in regard to the results obtained by the Hanseatic Insurance company, published in the Zeitschrift für Tuberkulose und Heilstaettenwesen, Oct. 1901. The ideal result for the insurance companies is to keep their members able to work

and so we find in their reports of those treated during each year the percentage given of those that are still able to do their full work:

Of those treated in 1895 57 per cent were workers in 1900.
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Of those treated in 1898 56 per cent were workers in 1900.

The total number of patients included in these statistics was 688; 34 of these could not be found; 69 (10.5%) were dead, 62 were unable to work, 107 were able to do light work, and 416 were able to do their full work*

About 9,000 tubercular patients were treated by these insurance companies during 1900.

From what we know of the possibilities of the proper use of food, rest and air, as understood in the modern sanatorium treatment of tuberculosis, it is no exaggeration to say that it is the best treatment for the poorer classes, which, however, can only be placed at their disposal by the aid of the state or municipality, or of private charity. The appalling death rate of this disease and the consequent amount of misery and poverty caused by it, in the face of the possibilities offered by its appropriate care, are an opprobrium upon our boasted Christian civilization. Here is a disease with a known cause, and hence preventable with a treatment known after fifty years of use to be curative in some 75% of all cases, and yet it is allowed to go on in our midst, a constant danger to every one, the greatest source of private misery and suffering and death and poverty, the destroyer of thousands of lives that would have added great wealth to the state if they had been spared, and yet there is no popular outcry for the state to open her coffers to battle with it, there is no association of rich and influential citizens to offer help and rescue to the thousands of poor sufferers, although the profession has for years known and pointed out that it was preventable and curable. Every municipality of 100,000 inhabitants should have a sanatorium and a hospital for consumptives. Every state should support as many sanatoria and hospitals for consumptives as the needs of the people seem to require. This is the most important step that state and municipal governments can take, both in their own interest and in the interests of their inhabitants. In order to lessen the spread of the disease, as Prof. Koch pointed out in his address before the London conference, if only a moder-

*Editorial in St. Paul Medical Journal, December, 1901.

ate percentage of all cases are segregated as has been done in the English hospitals for consumptives, the effect on the spread of the disease will be very marked indeed. In this way in a comparatively short time, the greatest change has been made in the number of cases of leprosy in Norway where that disease will soon be practically extinct.

In the United States a few states have built state institutions, but if any appreciable good in restricting the spread of the disease is to be accomplished every state must have them, and they should also have a hospital or hospitals where advanced cases can be taken and where their last days can be spent as comfortably as their condition will permit, and their families will not be exposed to the danger due to the presence of a dying consumptive in the overcrowded rooms of the poor.

BOVINE TUBERCULOSIS IN ITS RELATION TO PUBLIC HEALTH.

BY H. L. RUSSELL, PROFESSOR OF BACTERIOLOGY, UNIVERSITY OF WISCONSIN.

The disease bovine tuberculosis is one which primarily affects animal industry and we might speak especially of this, as it is one of the most important troubles which concern the growing of cattle, but it has also an important relation with that of the human family and it is this phase that is of greatest importance to us. The disease of bovine tuberculosis is one which is wide spread and has been known for a number of years, but the economic importance of it was not recognized until the last decade or perhaps fifteen years. In '92 what was called the tuberculin test, which was used primarily by Koch as a cure for human tuberculosis, was first introduced into veterinary science as a means of diagnosing the disease in cattle, and by this means we have practically gained most of our knowledge regarding this disease since that time. By the use of this test it becomes possible to recognize the disease in an animal at a very early stage, at a stage when the disease shows no apparent physical symptoms and therefore would not be recognized by ordinary methods. The disease in cattle, and in other domestic animals, as well as in human beings, is an exceedingly slow disease, and it is undoubtedly true that it is not often recognized in the earlier phases. With the introduction of the tuberculin test it became possible to deter-

mine whether an animal was affected with bovine tuberculosis or not. By the use of this test in various portions of the world a much larger percentage reacted to the tuberculin test than had been supposed to have been affected. During recent years this disease has been increasing with rapidity. There are portions of Europe which are at the present time very severely infected with it. In Denmark, a few years ago, not less than 40 per cent of all the animals tested reacted to the test. The condition is not very materially different in Germany, and the same is true in many portions of Europe. It has been found by application of tuberculin that fifteen to forty per cent of dairy cattle have reacted to this test. The condition with reference to the disease in America is not so severe. Dairying has not been carried on for so long a time in that extensive manner that it has in Europe, and we find that the disease here is not nearly so widely spread as it is abroad. There is more bovine tuberculosis in the east than in the west because the east has been engaged in the cattle business, particularly dairy cattle, longer than has the west. There has been more sale and interchange of stock, and this is the most important factor concerned in the distribution of the disease. Generally speaking, the disease is introduced into a herd by the purchase of an animal affected with the disease in the earlier stages.

With reference to the present amount of infection found here in this country, although the tuberculin test has been rather extensively used, the number of cattle which have been tested is relatively small. So far as tests have been reported to the United States Bureau of Animal Industry there is perhaps 15 per cent of the animals which have been tested that have responded. This figure is undoubtedly too high and does not represent the average condition throughout the length and breadth of the land; for in the great majority of cases the test has been applied to animals which were suspected to have this disease.

So much for the spread of this disease. While there is a good deal of it in the country at large, its presence is of most importance when we come to consider it in relation to the human type of the disease. We have in the human family tuberculosis produced through the inroads of tuberculous organisms. The same is true of cattle. The question arises: Are these two diseases found in the cow and man the same? Are they identical in all respects? I do not need to go into the differences that exist between the various types of disease as found in the bovine and the human races. This

is a question of mere scientific interest. But there is one question of importance; and that is, the difference in the virulence, i. e., the ability to produce a diseased condition, this difference being quite marked between bovine and human types of disease. Of course, you are all familiar with the recent statement of the German bacteriologist, Koch, who said there was little, if any, danger of the disease being contracted by the human from the bovine source. The arguments are undoubtedly familiar to all public health men and therefore need not be entered into in this connection, though there are two or three points which seem to indicate that the danger from the bovine is a great deal more marked than has hitherto been considered by Prof. Koch. Among these points we may mention the experiments which have been made between the human and bovine types when they have been inoculated into a series of animals. Take, for instance, laboratory animals, and the larger kind of animals which were inoculated from the human. Experiments made in this country, and later in Europe by Prof. Koch himself, show that the bovine type of the disease was more marked than where the disease came from human sources; i. e., that the disease is more virulent, affecting a larger number of species of animals than the human type of the disease, and that gives us a fair presumption that if we should artificially introduce both human and bovine type into man we would find that the bovine type of the disease would be more marked.

It would seem possible to prove this question. There are two or three ways in which this could be proven, and it is a problem for bacteriologists to consider here, and to consider well, whether it cannot be done in one way or another. The best way would be by direct introduction into the human being of the bovine type of the disease in order to see whether the organism was able to produce the disease. Such a method we are not able to carry out except under exceptional conditions, unless some one was willing to present himself for this purpose. This has been done with some diseases. In the case of those experiments in which human beings have presented themselves to the sanitary authorities for this purpose, it seems that if any one is to receive reward it is these "heroes of peace," who offered themselves for the good of mankind.

There is another way which will take a long time; i. e., the method of accidental inoculation. It is possible to collect statistics, although it will take a long period of time. There was presented at the London Congress this last year a number of instances where hu-

man beings had become accidentally infected with the tubercle organism, which was undoubtedly from the bovine source. This is most marked in the case of veterinarians and bacteriologists making post mortems on animals which have died from tuberculosis.

There are a series of observations which have been reported at the University of Pennsylvania, where three instances have come under the notice of the bacteriologist, Dr. Ravenal, where human beings have been inoculated. In one case it was impossible to isolate the organism from the tissues of the hand. The lesion was removed, inoculated into the animal. The animal died. The organism was isolated and shown to possess the perfect characters of bovine tuberculosis. It seems to me that one case of this nature, one observation of that kind which shows this accidental infection, goes a very long way in proving that the bovine type of the disease may infect the human being.

There is another way of proving the proposition: i. e., through the examination of hospital statistics. If we take the statistics with reference to tuberculosis in hospitals, we find that an alarming amount occurs among extremely young persons, and it is not the pulmonary form but is tuberculosis of the bowels. Under these conditions it seems to me that there is no other conclusion but that the infection arose from either the milk or food which contains the organism of this disease. The statistics which were collected in England show that 46 per cent of the children under one year of age died from intestinal tuberculosis, and only seven per cent died of tuberculosis of the lungs. We know that those conditions are entirely reversed when we consider the later stages of the disease; that the lung type of the disease is far more prevalent. Now the very fact that such a large proportion of the cases of tuberculosis in exceedingly young persons belong to this intestinal type, is very suggestive indeed, and proves, from the standpoint of statistical evidence, just exactly what these inoculations, accidental or otherwise, might bring forth The evidence proves, it seems to me, that the bovine type of the disease is, if anything, more virulent than the human type itself.

It is at least necessary for us to maintain that strictness with reference to the disposal of products from suspected animals, either infectious meat or milk, until such a time comes that it can be shown beyond all question that these restrictions are too rigid.

Now, what are the sources from which tuberculous bacillus may find its way from an animal to a human being, admitting that there

is this possibility of transfer? The modes of infection are through the meat and milk. The meat is of less importance than the milk, for the reason that the disease is generally confined to the visceral organs and these organs are not used. Then, again, meat is consumed in a cooked condition and under conditions where tuberculous organisms would have been killed by the heating process. So the danger from this source is certainly less than in the case of milk where the material is largely consumed in the raw condition, so that if milk contains this germ, under those conditions, the opportunity for infection is of course present. Now, with reference to the presence of tubercle organism in the milk. Admitting that there may possibly be ten per cent (I cannot give accurate figures) of our cattle affected with tuberculosis; i. e., so far as determined by the tuberculin test, what are the probabilities of acquiring disease from this source. Now it should be borne in mind that not all milk of animals reacting to the tuberculin test possesses the organism of the disease. The milk is highly infectious wherever there are lesions in the udder; wherever the udder is infected undoubtedly the milk of those animals is highly infectious. This can be readily determined. When such milk is inoculated into animals it results in a rapid, acute, generalized tuberculosis.

On the other hand we know that a large number of reacting animals are not in a condition where their milk is actually infectious. In the early stages of the disease, where the disease has not been generalized, and where the lesions are in the earlier stages, the milk rarely contains the organism producing this disease.

Again, there is an intermediate group of cases where the disease becomes more generalized, spreading throughout the system, and still there may be no physical manifestations of the trouble. In such cases the actual condition of the milk with reference to its bacterial content cannot be foretold. In such cases it is necessary to determine by the microscope whether the tubercle form is present or not.

Now what shall we do with the milk of these animals, admitting that there is a certain percentage which is known to be infectious, and recognizing that the most of it does not contain the organism? Of course, the only thing is to exclude, so far as possible, the use of all milk from such animals as respond to the tuberculin test. Why should this be done? If there are animals which react, we must exclude the milk of these animals for the reason that, while an animal may not have the organism in its milk, we do not know at what time the disease may become generalized throughout the

animal. Often a reacting animal may maintain itself without any material change for a number of years. I have had cases of tuberculosis where the animals continued to react for a period of five and six years, and apparently did not run down in any way. Then suddenly, without any premonition, the disease changed from the chronic to the acute type, and the animal quickly declined. When this happens, the milk of the animal, which has hitherto been entirely free from the tubercle bacilli may contain the organism in a very short time. Recognizing this danger it is therefore necessary for us to exclude in every possible way that we can the milk from all animals that respond to the tuberculin test.

This may be done by exclusion or destruction. We may either exclude the milk or treat it in a way so as to destroy the organism if it is contained therein. Either method is practical. It is possible to exclude the organism from our milk supply by passing laws compelling the application of the tuberculin test to dairy herds. This is done in various portions of the country. In this way the milk of all reacting animals would be excluded and the danger from this source warded off.

There is the other method of which I have spoken; viz., the destruction of the bacteria which may be in the milk. This can be done by the application of heat. These organisms are destroyed by the action of heat just the same as all other living forms are. Therefore, it is possible, by pasteurization, or sterilization, to destroy the vitality of the tuberculous organism. The method which has grown to be the most important in this country, the one which is most generally followed, is that of pasteurization, so called after L. Pasteur. This requires a temperature of 140-150° F. for 15 to 20 minutes. Under these conditions the germ loses its vitality, if present. You also destroy any other organisms which may be in the milk. Pasteurized milk will have its keeping qualities enhanced about two, three or four days, depending upon how it is handled subsequent to being pasteurized. If pasteurization was carried out in the city dairies, this would result in the complete annihilation of all organisms of a diseased nature, and particularly tubercle bacilli. There is one point more which I wish to speak about regarding pasteurization. If we go to work and pasteurize milk in an open vessel, a scalded layer forms on top of the milk. Under these conditions the vitality of the organism is much increased. The tubercle germ is killed at 140° if heated in a closed vessel, but it will retain its vitality for a period of four or five times as long when

that exposure is made in an open vessel where this scalded layer forms. This is of importance in pasteurization.

With either of the methods of exclusion or destruction it is possible to eliminate all danger from this disease.

The President: These papers on tuberculosis are now open for discussion.

Dr. J. W. Bell (Minneapolis): Mr. President, Ladies and Gentlemen: The excellent papers to which we have listened leave little to be said on the topic before us,—tuberculosis. The problem of the control of this disease we have had before us all these years and probably will have to the end of time. The control and extermination of this disease is still an unsolved problem. In the main I agree with the statements made by the essayists, both of them. Two points I think, perhaps, should have been dwelt upon more forcibly. First, that tuberculosis is the joint product of seed and soil. We have waged our warfare largely along one line, in the past, in an effort to destroy the bacillus without regard to the soil.

Three things are settled, at least, in regard to tuberculosis: First, that is a feebly contagious disease; second, that it is a preventable disease; third, that it is curable in the first stages of the disease. I refer to pulmonary tuberculosis. The disease, in my mind, is feebly contagious. I do not think we gain anything by the effort made in certain directions to attach to the disease the stigma of marked contagiousness. It should be considered a communicable disease, contagious under certain circumstances, especially where persons are closely related,—husband and wife, mother and child, etc. If we take this view of the disease, and I think it is the only true view we can take, it seems to me that we should then give more attention to the second important feature in connection with this problem; viz., the influence of the soil, predisposition, inherited or acquired, for we have both, in my judgment. In very few cases have I been able to determine the fact of the existence of contagion. It is a difficult fact to establish. At the London Congress an English physician, in a paper dealing with some 716 cases of this disease treated in various sanatoria, was able to develop a history of heredity in 52 per cent of the cases. In that group of 716 he was only able to find out definitely a percentage of 2½ due to contagion.

If we are to conquer in this struggle with the white plague, and, to be candid, we certainly have not made much progress during the last two decades, it must be by giving at least some attention to the

soil, and not centering all our artillery on the bacillus,—not that I would for a moment wish to belittle the influence of the exciting cause of tuberculosis. But if there is one thing settled definitely in connection with this disease it is the fact that it is the joint product of soil and seed, and unless we can do something toward improving the soil, and most certainly unless we can make more headway in the direction of destroying or exterminating the bacillus, we will make very little progress in the control of this disease.

If the state is to care for the needy, and I am firmly convinced that it is right and proper that it should do so through the erection and maintenance of suitable sanatoria and hospitals, I think the state should go still farther and prohibit the marriage and intermarriage of consumptives. The intermarriage, especially, of consumptives should certainly be absolutely restricted. If the state has a right to prohibit consanguineous marriages it certainly should have the right to interfere and prohibit the intermarriage of consumptives. Tersely, I think we may say, as we breed so shall we reap, and unless we can do something toward improving the soil, in my judgment, we will wage, as we have in the past, a war that is largely fruitless. If we have made any marked gain in the control of this disease we have made it without, perhaps, intending to improve the soil, but along the line of destruction of the bacillus.

In England, where there can be no question but progress has been made, the improvement is largely due to the fact that they have wisely, for a number of years, legislated so as to bring about a better sanitary condition of things in respect, especially, to the workingmen of that country. They have ventilated their workshops and factories, and rendered them more cleanly. They have brought sunshine into tenement houses, and have accomplished much thereby in diminishing the acquired predisposition to this disease. There is no reason why the state should not claim the right to prohibit the intermarriage of consumptives, so long as it proposes to reach out and care for the unfortunate consumptives. The disease may then be said to be communicable, or feebly contagious; preventable in a large measure, although so far we have, as we know, made but little progress, and it is certainly curable if detected early. It is unfortunate, it seems to me, that this disease is so often unrecognized until quite late. Our medical colleges should take note of the fact that our medical men of today, in spite of the fact that they are receiving more and better instruction, frequently overlook the disease until a late date,—too late to effect a

cure. The best treatment for tuberculosis may well be said to be an early diagnosis. Unless the disease is detected early, it is immaterial whether we treat it in the cellar, garret, or sanatorium. An early diagnosis is the all-important thing so far as the treatment of the disease is concerned. The treatment of the disease in suitable sanatoria is the best method of treatment known to-day, and yet it is not ideal.

I believe this state should take up this subject, and should build a suitable building and take care of the consumptive poor. The disease is of long duration; it is a severe tax upon the individual suffering from the disease, and a greater tax upon the relatives. A consumptive is very much like a wounded soldier,—it requires at least two other bread winners to care for him. In my judgment, the state should take hold of this problem in two ways. It should claim the right to interfere, and prevent as much as possible, by wise and judicious legislation, the intermarriage of consumptives, and it should reach out, by way of suitable sanatoria, and care for the consumptive poor.

Dr. Burnside Foster (St. Paul): Ladies and Gentlemen: It seems to me that the function of an association, which I hope will be the result of this conference, is two-fold. It is partly to discuss from a scientific point of view the methods of contagion; how to handle them and how to take care of them; and partly to discuss in what manner people may best be educated upon this subject; for without the interest of the people the medical profession can do but little. When the king of England, who was then the Prince of Wales, was attending the conference which had tuberculosis under discussion, in London a few years ago, he said: "If preventable, why not prevent it?" It is the answer to this question that we must expect from such a body as this. It seems to me that the thing needed is the education of the people, and one of the greatest benefits of such a meeting as this is the bringing together for one common purpose and common interest the medical profession of our state who are studying these interests, and the people who want to learn something. The best way to educate people is by dissemination of suitable literature which should emanate from an authoritative body such as this association. I hope that one of the results of this conference will be the general dissemination of popular, suitable literature among the people at large upon the subject of tuberculosis and its prevention, and also upon the prevention of other preventable diseases.

Dr. Tomlinson (Hospital for the Insane, St. Peter, Minn.): The prevalence of tuberculosis in the hospital at St. Peter has made the disease the subject of study and deep interest to us. This interest was enhanced by our experience with bovine tuberculosis some years ago. Between 1894 and 1899, we practically renewed our herd of milch cows on account of tuberculosis. We killed, altogether, about 65 cows, all of them having responded positively to the tuberculin test. Thirty-five were killed at one time; and all of them were found to be diseased. In carrying out the work the cows were handled principally by our herdsman and a patient who worked with him. To hold the cow, it was the custom to put the thumb and fingers into the nostrils, and these men were not particularly careful nor cleanly. Within six months of this time this patient died with tuberculosis; and the herdsman was ill with the same disease. In the early stage of the disease the bacilli of bovine tuberculosis were present, but so also were those of human tuberculosis. While these cases were not so carefully studied then as they would be now, the fact that there was no tuberculosis in the family of the herdsman would suggest that the primary infection was bovine; especially as he was not in the way of being infected with the human form. The patient lived in a part of the hospital where tuberculosis had never developed. It is true that other employes and patients helped with this work, but only occasionally.

We have the source and means of infection with human tuberculosis with us always, and large numbers of patients are equally exposed; but only a comparatively small number have the disease. Further, we have, at different times, taken swabbings from the throats of patients indifferently, and obtained cultures of the tubercle bacillus; and as yet none of these patients has been ill. It would seem, from our experience, that the susceptibility of the individual is an important factor which is too much overlooked.

The so-called experiments in inoculation referred to in the newspapers, even if they were carried out, would have no value in determining the possibility of infection of human beings with bovine tuberculosis, because the fact that these individuals were not infected might simply be an indication of natural immunity.

I believe, from my observation of tuberculosis in a public institution, that in its acute form, tuberculosis is more common even than it is now considered to be. When it is remembered that the disease is seldom recognized until it ceases to be simple tubercu-

losis, and becomes a mixed infection; that what are considered by the laity to be its characteristic symptoms are the result of septicemia, following infection with the pus-forming bacteria,—it may be readily realized how little familiarity we really have with the degree of its prevalence.

I believe that a large number of cases of illness diagnosed as bronchitis, or broncho-pneumonia, are really cases of tubercular infection, occurring in the comparatively immune, who are temporarily suffering from impaired vitality. Very many of these cases are not under the care of a physician, and those which are do not, by their condition, suggest to the medical attendant the advisability or necessity to examine the sputum. These cases usually recover from the immediate attack; and yet may be the innocent means of spreading the infection to others more susceptible. Or the bronchitis may become chronic, still not be recognized for what it really is, and thus become a constant source of supply of infective material. I was very much interested by a paper which appeared a short time ago in the London Lancet, in which the writer dwelt upon the importance of trying to impress upon the public the importance of the early recognition and treatment of tuberculosis, and especially upon the members of those families in which there is a known susceptibility to affections of the lungs.

It is important, also, to remember that any constitutional weakness in the parents may predispose the child to weak lungs; so that any lung affection which persists, or produces an amount of constitutional involvement, out of proportion to the apparent disease, should be carefully investigated; because, while there may be no infection at the time, the part of the lung involved may become the nidus from which will start a tubercular infection, under the influence of impaired vitality, at any time. Unfortunately, the susceptible individual does not recognize the nature of the disease because the apparent involvement is so slight that he does not realize his illness, nor the importance of treatment both prompt and persistent. When the importance of early treatment is more appreciated by the public at large, the incidence of tuberculosis will diminish. However, human nature is so constituted that I do not believe it will be ever wholly eliminated, for we always think of our own convenience and comfort first, and are willing to discount the evil day. So that while tuberculosis has been proven to be a preventable disease, and the possibility of its elimination from our mortality lists demonstrated mathematically, still it is well to re-

member that we are dealing with human beings, and that there will always be loose ends which we cannot pick up.

Dr. Norred (Minneapolis): Ladies and Gentlemen: I feel very proud tonight in contemplating the beginning of such a move as this one. I certainly think that the move is in the right direction. While we do not expect to take a scythe and walk out from this hall tomorrow or next week and mow down and destroy all the disease in the country, I certainly do think this a move in the right direction. I have certainly enjoyed the papers read tonight very much indeed and I think they have been very much to the point and deserve great credit. I cannot help but emphasize the expression voiced by Dr. Bell and Dr. Tomlinson relative to the importance of the early diagnosis of tuberculosis. I believe that we all are rather inclined to be careless in this matter. It is a fearful responsibility. We turn a case away from us, stating simply: "You have a little bronchitis, or a little grippe, or something that will pass away in a few days," and really do not recognize the fact that we have instead, consumption in its incipiency to deal with. We are thus leading the patient along to sure destruction. We are the guides, and if we neglect our duty we are depriving him of the benefit that he is expecting to receive at our hands. With me this is a matter of conscience. I am glad to feel that there are many good men in the medical profession. I believe the important thing is to be sure of your diagnosis in the first place. Diagnose early. Then I believe that the sanatorium treatment under the proper regulation is the next important step. I certainly believe that the intermarriage of consumptives ought to be prohibited.

Dr. Bayley (Lake City): I wish to say that I, too, believe in the early diagnosis of tuberculosis as an important factor for the satisfactory treatment of this disease in sanatoria.

I also wish to emphasize the importance of the separation of the tuberculous from the non-tuberculous individuals, as shown by the experience of Colorado. It was formerly thought that the non-tuberculous in that state could not contract this disease so long as they remained at home. I understand that during the past few years this has changed and that it is now recognized that individuals may become infected with tuberculosis while resident in Colorado. It is stated that in the city of Denver many of the homes that have been inhabited by tuberculous patients from the East have become breeding places for tuberculosis.

Dr. D. Edmund Smith (Minneapolis): I am unusually interested

in the subject of tuberculosis. During the summer I attended a session of the Laennec Society, a society which has for its object the study of tuberculosis. A number of physicians were at a national convention in Washington, several of whom came to John Hopkins to speak at this meeting. I had the privilege of hearing these men who are foremost in the effort to prevent and overcome tuberculosis. As a result of conversations with several I decided to visit their sanatoria for consumptives.

At Sharon, Mass., about forty miles from Boston, with an elevation of six hundred feet there is a small sanatorium for twenty-six women where they pay five dollars a week for their care. The balance is furnished by private contributions. Dr. V. Y. Bowditch has control of the institution. The results are remarkable. It has been in operation for eleven years and the percentage of "arrested cases" or what are termed cured,—that is when the baccilli have disappeared from the sputum and has remained so,—is twenty-five. Five per cent are dead and the remaining seventy per cent, all of whom would have been dead by this time, although sputum can be raised with the bacilli in it, are able to support themselves and are well. They are compelled, however, to take the very best care of themselves.

At Rutland, Mass. about 70 miles from Boston, with an elevation of 1,200 feet, is situated the state sanatorium, accommodating 176 patients. This institution costing $150,000, has been open for years with a percentage of recoveries of eighty-two and a fraction. The institution, while cared for by the state is free from political influence and under the direct control of Drs. Bowditch and Clapp of Boston. Such an institution can never be a success when its control is thrown open to men who are given the positions because of their work and faithfulness to a political party. It requires men peculiarly adapted to this work to make these places of the greatest service to the community.

From Rutland, I went to Dr. Trudeau's Cottage Sanatorium at Saranac Lake in the Adirondack Mountains. One hundred are being cared for there. It is really a wonderful place, the growth of eighteen years of persistent, painstaking effort. His laboratory, costing $40,000, in which are tested all the methods and drugs put before the public for the cure of tuberculosis, would take a long time to describe.

During this visit I saw over three hundred consumptives getting well. They were the healthiest, fattest, brownest and happiest

lot of invalids I ever saw gathered together. I heard very few people coughing. In each of these institutions there was only one death last year. The wonderful fact about all these people was that they were all getting well. This remarkable death rate is due to the fact that only the incipient, but at the same time well marked, cases are received. The diagnosis is always confirmed by tuberculin, bacilli, or the Roentgen ray.

The sanatorium at Rutland is the very best means the state can furnish to educate the masses.

After from five to eight months sanatorium treatment these patients go home and carry out the treatment learned during their sojourn. They are careful about spitting on the floor, and the use of dishes, bedding, etc. They teach their families to dread and to be careful about the disease and their example and influence is felt in their immediate neighborhood, for these patients know the value and necessity of fresh air (and plenty of it), sunshine and clean homes. Any one known to expectorate on the ground or floors or sidewalks is immediately dismissed from these sanatoria because they are taught that consumption is contagious and they are endangering others. Every individual saved to the state has an economic value of $1,000. It is the wage earner who is generally the tubercular victim. Unless he is returned to his family or preserved to care for them the burden must fall upon the state.

Dr. Millet of Brockton, Mass., is doing a wonderful work among the shoe factory employes. These men are not able to leave their work so they have porches made on which they sleep nights and are given places in the factories with the greatest amount of light and air. This has led to the demand among the healthy employes for better accommodations in their homes, larger, brighter, more sanitary factories. Their main treatment is living out of doors as much as possible.

In this way these cured patients are the cheapest, most effective educators the state can produce. One of the greatest, most comforting facts to me was that these people could get well at home without being compelled to go to New Mexico, Colorado or California, a burden a very small per cent of the people can carry. Just think of it, being cured within forty or fifty miles from the foggy New England coast where they can see their families and not die of homesickness.

That same thing can be done in Minnesota where the altitude and dry bracing air can be had in abundance and the amount of

sunshine is unusually large. The treatment is simple and does not require great skill, but one of the main requisites is that the patient shall be where he can be directly under the thumb of the doctor who shall direct his movements, diet, rest and occupation. I came back to Minnesota with enthusiasm enough to build several sanatoria but have not been able to complete one as yet. However, if we cannot have sanatoria we can cure these people in their homes if they can be made to follow one's directions. I was able to do that in Minneapolis during the coldest part of the year. Since coming under my care October 15, 1901, my patient has advanced from 127 pounds until today he weighs 150 pounds. During the days when our thermometers registered 32 degrees below zero he was out of doors seven hours. His cough has disappeared and in the last two examinations I have been unable to detect the bacillus in the sputum. He has returned to work, but of a different character from that which he formerly had.

Tuberculosis is spreading in Minnesota, and it remains for the physicians of the state to control it. One of the best ways is to establish a sanatorium not in the northern pine woods where the soil is boggy and the humidity is very high, but on the hills within a few miles of the families and homes of the patients where they will not be shut off from each other by the expense of railroad fares. These institutions should charge a moderate fee as in all the other sanatoria in the country and the balance should be paid by the state. The actual cost in maintaining each patient is $7.79 per week in the larger institutions. Dr. Trudeau goes to New York each year and asks for donations amounting to $10,000 for the maintenance of his sanatorium.

I received a letter from Dr. Marclay, the superintendent at Rutland, saying that four states had since my visit sent commissions to inquire into the treatment of tuberculosis and the methods of handling this disease in Massachusetts. He predicts that it will be a very short time before every state in the Union will have a place for the care and cure of consumptives.

I am pleased to know that in a few days a party from Minnesota, appointed by the Governor, is to make a tour of investigation. I believe that the state of Minnesota can take up the question and give better reports than any sanatorium has as yet been able to give.

It will be along the lines that are adopted in every European nation and in the general progress of our science, and a natural sequence of such progress to have a state sanatorium in Minnesota.

Dr. Reynolds: I wish to speak of bovine tuberculosis. So far the discussion has related to human tuberculosis only. I hope the medical men here present will not forget that there is a great deal of bovine tuberculosis in Minnesota in our dairy and breeding herds. I hope the medical men will not lose sight of this because it is very important for many reasons. I have been led to suspect, during my experience of several years in the state, that comparatively few physicians have a suspicion of the amount of bovine tuberculosis existing. Those who have been connected with the work, directly or indirectly, of our Twin Cities, know how general is the presence of this disease, but those in general practice know little of the conditions, not because they are not interested but because they are so busy with other things and this condition is not brought to their attention at all. I would like to see the medical men of Minnesota take a very active interest in bovine tuberculosis.

Dr. Bell (closing the discussion): The tuberculosis problem is a complex one, and should be viewed as such, hence our efforts should be directed, not alone to the destruction of the bacillus tuberculosis, but along all lines tending to improve the character of the soil, thereby minimizing the danger of bacillary infection.

The meeting adjourned.

Minneapolis, Wednesday, Jan. 15, '02.

The meeting was called to order at 10:05 a. m., in the bacteriological laboratory, University of Minnesota, by Dr. Bracken.

As Dr. Hutchinson was not able to be on hand, for a short time at least, Dr. Tomlinson was requested to take the chair.

Dr. Tomlinson: The Conference will be in order. The programme opens this morning with an address of welcome from the President of the State University, President Northrop.

President Northrop: Mr. President and Gentlemen, I did not know until a few minutes ago, when I reached my office, that I was expected to give an address of welcome this morning. If there is anything I dislike it is an address of welcome, whether given by me, or to me, and especially when there are several addresses of welcome representing everything in the vicinity. I have only one this morning, and I shall give it in a very few words. I think we are agreed, notwithstanding what literary men have discussed, that life is worth living, and if it is worth living, it is worth preserving, and if worth preserving, it is worth guarding. You gentlemen, who have come here in the interest of superior knowledge, looking after the health of the state, are therefore engaged in one of

the most important works that can engage the attention of man. That spotted card (referring to the smallpox map) shows, as nothing else could, the necessity for the greatest care on the part of the medical men and wise men of the state in preserving the health of the state; and it is impossible to preserve that health, to guard against epidemics, to prevent their spreading, except by concert of action by qualified and intelligent men such as you are. I am glad this conference has been called, and I am doubly glad it has been called to meet here in the medical department of the University. I give you a hearty welcome and the freedom of the University, not only the medical department but every other department.

Go on and consult, and do the best you can for the people of the state in regard to health. Do not be weak because some people do not like to have measures taken to prevent the spread of disease. The public good is of the greatest importance. Public safety is what you want to consult about, and in the interest of public safety a great many cases of individual inconvenience must be borne. I hope you may be governed by the greatest wisdom in your councils and may arrive at conclusions that may be of good to the state. You should work together for the preservation of the health of Minnesota and the general good of her people.

I give you a very hearty welcome to the University and all it contains. I should be glad to see you all over in my office and should be glad to show you any attention I can.

Dr. Tomlinson: On account of a change made on the programme, we will pass to the subject of Diphtheria. The discussion is to be opened by Dr. J. H. Adair.

Dr. Adair: Mr. Chairman, Ladies and Gentlemen, The subject of diphtheria has unfortunately demanded a large share of public and professional attention in this country during the past fifty years; during the greater portion of which time efforts to abate its spread, or modify its fatality were to all intents unavailing.

From the time of its first recognition as a specific disease it has been everywhere considered as *par excellence* the destroyer of childhood. The fear of its invasion has been an ever present terror in all communities, while its successful treatment, until very recently, has been the despair of the profession everywhere.

In attempting to give some idea of diphtheria, as it reveals itself clinically, it will be understood, I trust, by all, that with a disease so multitudinous in its manifestations, attacking, as it does, not only the infant and child, but the adult as well; having in itself all grades and degrees of severity; insidious and treacherous in its

most deadly forms, leaving oft-times in its wake permanent disabilities; it will be impossible for me, in the brief time allotted, to give more than an imperfect sketch of its principal features, as I have observed them at the bedside.

Diphtheria is a malady of childhood, and while it does not spare any age, it attacks by preference those between the ages of two and twelve.

The laryngeal form of the disease is more apt to occur in children before the fifth year; the pharyngeal form at all ages, but with its greatest frequency between two and seven. Following the general rule of the exanthems, diphtheria is infrequent during the first six months of infancy, but has been met with by competent observers in the new-born, in a small proportion of instances.

First, among the clinical manifestations of the disease, I have been impressed with its rapidity of onset, as compared with that of other and benign inflammations of the throat. The patient looks sick, and his whole appearance in the course of a few hours is that of an individual suffering from some serious disease. This condition is in marked contrast to that which obtains in the presence of various diseases of the same tissues, where the child may go for days, or even a week, without marked evidences of systemic disturbances manifesting themselves.

An early and distinctive feature of the disease, very striking at times, is the peculiarly angry color of the tissues, which later are to be occupied by the pseudo-membrane. The inflated aspect of the mucous surfaces well defined, and shading off very suddenly into the normal pink hue of the unaffected tissues, is observed oftener in cases of diphtheria than in any other disease of the throat, and is a diagnostic point of some value.

In a fair proportion of cases, there is a peculiar fetid odor of the breath, which will be noticed at the first inspection of the fauces, and which once experienced will never be forgotten, while the tongue has a fawn colored coating, not leathery but very smooth, and in many instances slightly glazed.

The temperature in diphtheria is not distinctive. It ranges from 99 to 104 degrees. Ordinarily there is very little increase at the inception of the disease, and the average, in cases which I have observed, has been 101 degrees. In this connection it is well to bear in mind Jacobi's dictum, that cases of *uncomplicated* acute laryngeal catarrh are always accompanied by fever, while cases of *uncomplicated* laryngeal diphtheria (pseudo-membranous croup) are not so accompanied in a large proportion of cases. So far as the gross

appearances of the diphtheritic membrane are concerned, we may divide them into two varieties. The first is a thick, heavy, leathery exudate, firmly attached to the tissues upon which it rests, and which bleeds easily upon its forcible removal; grayish white at first, changing rapidly, however, to a dark color, and even black appearance, and which almost without exception occurs upon one or other of the tonsillar surfaces. This variety, in my experience, is always accompanied by the presence of *B. diphtheriæ.*

The other variety consists of a thin, pellucid membrane, never becoming thick or leathery, never firmly attached to the underlying surface, which may have its starting point on any portion of the buccal cavity, infrequently beginning on the tonsils, and which creeps over a large territory. It has to the naked eye the appearance of a blister set upon the mucous surfaces. This is the type of membrane which may or may not contain *B. diphtheriæ.* It is also the form of membrane which proves so resistent to the action of antitoxin, frequent injections of large doses having absolutely no effect, so far as its removal is concerned.

It is needless to say that this latter form is chiefly a mixed type of infection, various forms of strepococci and staphylococci being present in the same case. Where the tonsils are occupied by the pseudo-membrane alone, they are apt to be implicated in rotation, the membrane in the first instance attaining its greatest dimensions before the opposite side is affected. Beside the tissues already enumerated, the other points of most frequent election for the presence of the diphtheritic membrane are, in the order of their frequency, the larynx and the nasal cavities.

Where the disease attacks the larynx, it is apt to be primary; any extension from the throat, in my experience, being rare. In a few instances the upper edge of the membrane extends up beyond the glottis, rendering these cases where it occurs easy of diagnosis. Generally, however, the membrane remains hidden from view throughout the entire course of the disease, except when mechanically expelled by coughing or other effort on the part of the patient.

The second location in point of frequency, as has been already mentioned, is the cavity of the nose. Here, in contradistinction to the laryngeal type, the infection is secondary, instead of primary. It is the result of a direct extension of the infectious process from the fauces to the nose, and is not, so far as my experience goes, of very frequent occurrence. Both of these types carry with them their own dangers; the laryngeal from the ever increasing tendency

to fatal stenosis, and the nasal from the well-known liability to toxic absorption from the extensive infection.

The prominent characteristic in the cases of nasal diphtheria which I have encountered has been the occurrence of hemorrhage, more or less profuse. This is ordinarily associated with a thin and acrid discharge from one or both nostrils, which excoriates the surfaces over which it flows.

The immediate danger in any given case of diphtheria is in proportion to the amount of toxic absorption, and this is fairly well gauged by the condition of the cervical lymphatics. Particularly obnoxious in my experience have been those cases in which well marked glandular involvement has preceded the appearance of the membrane. Such instances, in which the angle of the jaw is obliterated very early by the rapid swelling of the neck, evidence a condition of grave danger. These are the cases which, before the days of antitoxin, inevitably succumbed in spite of all treatment. They will die now very promptly and effectually, unless the use of heroic doses of antitoxin is supplemented by energetic and continuous stimulation.

It is sometimes necessary to distinguish the diphtheritic membrane from three or four other forms of inflammation affecting the tissues of the throat. The first in order of frequency is the follicular type of tonsillitis. Here careful inspection shows that the exudate is extruded from one or several crypts of the tonsil; is in the beginning pin-point in size, rarely coalescing to cover large areas; has not the dirty hue of the diphtheritic membrane, but, on the contrary, retains its whitish color to the end; above all else, can be easily wiped from the surface with a cotton swab, and when once removed does not tend to recur, as does the other.

The angina of scarlatina is sometimes accompanied by a membrane similar in appearance and composition to the one already mentioned as being the result of a mixed infection. The distinguishing feature of this form of inflammation is its diffuse redness. An examination of the child's mouth and throat in severe cases shows the roof of the mouth, the fauces, and, in fact, all the tissues within the line of vision, to be of this uniform scarlet hue. In addition there will occasionally be seen on the roof of the mouth enlarged papillæ similar to those found on the tongue, and which produce the characteristic "strawberry" appearance of that organ.

The ulcerative stomatitis of children has been confounded with the lesions of diphtheria, but this would seem to be uncalled for where care has been taken in the observation of the two diseases.

The first named disease occurs in irregular patches, selecting by preference the neighborhood of the gingival surfaces, is an excavation rather than a membrane; is ordinarily filled with pus shreds; has ragged edges; erodes and bleeds easily; and, unless the lesions occupy a large surface, is not apt to produce marked systemic disturbance.

Occasionally in children and aged persons, in the latter stages of long continued and wasting fevers, and particularly in the severer forms of typhoid infection, there is deposited over the tissues of the throat and cheeks, and even the tongue, a fetid, ill-smelling membrane, not thick; pasty in character; in places resembling the diphtheritic exudate, but without producing any apparent ill effect upon the patient beyond that engendered by the original disease. This is the so-called pultaceous pharyngitis.

The poison of diphtheria expends its force upon other parts of the system than the throat. The first in order of frequency is the peripheral neuritis, with its resultant paralysis and the more or less profound degeneration of certain muscles.

Some form of paralysis will accompany almost every case of diphtheria. I believe that the most frequent type of paralysis, if it may be termed paralysis, is that which produces the impaired and irregular action of the heart, so notable in the course of this disease. Very few cases of diphtheria, in my experience, occur without manifesting more or less weakness and irregularity of the cardiac muscle. Nothing distinctive is determined in these cases by an examination of the heart, except that the rhythm is slow and irregular and the sounds muffled and weak.

The next most common form of paralysis in diphtheria is that affecting the special muscles concerned in the act of deglutition. After the disappearance of the membrane, some time during the period of convalescence, it is noticed that the child has difficulty in swallowing and is apt to regurgitate fluid through the nose. The paralysis may not extend further than this, nor is it apt to be unduly persistent.

The one most constant nervous symptom following an attack of diphtheria is the absence of the knee-jerk; and many cases seen after the subsidence of acute symptoms, where the previous history is obscure and uncertain, may be diagnosed by this alone. The average proportion of cases of paralysis following attacks of diphtheria in all forms and varieties, as reported by competent observers, is probably not far from 25 per cent. The sweeping assertion of Rotch that cases of diphteritic paralysis invariably recover I am convinced

is not borne out by the facts, inasmuch as the condition of general debility produced by well defined and general paresis has more than once in my own experience gone on to a fatal termination.

The next most frequent complication of diphtheria is albuminuria. This is present in from 15 to 25 per cent of all cases. The time of appearance of the albumin is on an average of about one week to ten days from the inception of the disease. The amount of urine is, of course, decreased, and unless albumin is present in large quantities, there is practically no œdema in these cases. The albumin is prone to vary from day to day in amount, and traces may remain in the urine for months. The color of the urine is not distinctive.

Bacteriology of Diphtheria.—The thick leathery form of membrane is almost invariably associated with *B. diphtheriæ.* The thin or pellucid type may contain only staphylococci or streptococci, or both; the *B. diphtheriæ* may be absent during the entire or the greater portion of the disease.

The chief point of interest in the consideration of the bacteriology of diphtheria, and one which has a direct bearing on the question of treatment, is the difference in the virulence of the specific bacilli. The presence of *B. diphtheriæ* in a throat is no evidence of its virulence. In order to be certain of this and demonstrate the degree of toxicity possessed by the bacilli, it is necessary that cultures be taken and tested through animals.

There is no one point which is better settled, I believe, at the present time, and which is of greater importance to us all, particularly to those members of this conference who are concerned and charged with the care of the public health, than that the throats and noses of healthy children are very apt to contain the germs of diphtheria. The child who is furnishing a lodgment for the bacilli of diphtheria in his throat or nose may himself never have had any of the clinical manifestations of this disease and still be all of the time a walking menace to the community.

The persistence with which the bacilli of diphtheria retain their hold upon the throats and noses of healthy children is remarkable. One case coming under my personal observation showed *B. diphtheriæ* in the throat eighteen months after the disappearance of all the clinical manifestations of the disease, while one hundred and eighty days after the subsidence of the acute stage, the bacilli were virulent enough to kill a guinea pig, and a pure culture of *B. diphtheriæ* was obtained from the site of inoculation.

The condition is further complicated by our inability at the present time to certainly rid the throat and nose of bacilli by any therapeutic measures in the shape of sprays or washes to the parts. I do not believe that we have any form of medicine or treatment in the shape of local applications that is sufficient to thoroughly cleanse the throat and nose of *B. diphtheriæ.*

There are several other points which might be mentioned in this connection, but I feel that I have occupied all the time I should. I cannot close, however, without saying that it should be a matter of pride and congratulation to us all to know that in placing the bacteriology of diphtheria on its present firm foundation this laboratory, under the guidance of its accomplished director and his able assistants, has accomplished the most important work in this country in this connection, and the views and investigations formulated by these observers have furnished the essential basis for similar work done in other states along this line.

Dr. Tomlinson: The subject has a general interest and it is important that all those who are interested in sanitation should get as much information as possible from the discussion. I think it would be not only very interesting, but of great advantage to the conference, if Dr. Wesbrook would discuss for us something, more especially the bacteriology of this disease.

Dr. Wesbrook: Mr. Chairman, Ladies and Gentlemen, I had hoped to hear a great deal from the demonstrative end of the question of diphtheria infection to-day. I have had correspondence with many of the representatives of the various health boards here present and would like to hear how the laboratory investigation of diphtheria affects the health officer in the administration of the affairs of his office, as of course in the laboratory we are entirely dependent upon the data which we receive by means of the data slip which the physicians or health officers forward with the specimens as they come to the laboratory. It is quite possible for us in this way to get misconceptions of the conditions which exist, and that is what I am particularly interested in finding out. We want to learn the extent to which the laboratory examination can be taken advantage of in the country and also as to whether it can be improved upon. We want to have many suggestions concerning the best means for the quarantine and management of diphtheria cases so as to prevent infection. That is, I take it, what we are chiefly interested in.

Dr. Adair has well shown in the opening discussion that there are certain clinical types, certain pictures, noted at the bedside in

the clinical study of diphtheria, which we in the laboratory do not know as much about as we should. There are certain of these types in which we are likely to find diphtheria bacilli present. There are certain other types in which we are not so likely to find diphtheria bacilli present, at least not so frequently. These latter ones are not amenable to treatment with diphtheria antitoxin. We have two means of finding out whether diphtheria is present or not: one by examination with the microscope of cultures, and the other by noting the effect of diphtheria antitoxin. Dr. Adair intimated that in some cases which did not respond to antitoxin the diphtheria bacillus might be present. I may quote one case illustrating the fact, that even though diphtheria may not respond to diphtheria antitoxin, the diphtheria bacillus may be present. The case was in Minneapolis. In the early days of the disease, when there was every opportunity for satisfactory treatment, very large doses of antitoxin had been given by the physician—I think 20,000 units altogether. The patient died and we found *B. diphtheriæ* present, and far outnumbering them was the streptococcus of septicæmia. That gave some clue to the condition. We probably find a majority of the second class to which Dr. Adair referred due to streptococci.

There are other causes which may produce diphtheria-like conditions. They may be present with or without diphtheria.

I will tell you some of the things which we have to contend with in the laboratory. First, very often we do not have sufficient data. We are apt to misunderstand those with whom we are collaborating; they may possibly misunderstand us. The chief value of the laboratory report is, I think, sometimes lost sight of. It is not for its use as a guide to the administration of antitoxin, since there would then be too long a delay in the administration of an important remedy, but it is of value in showing the necessity or not of quarantining or isolating that patient. If clinical conditions demand it, give antitoxin without waiting to hear from the laboratory.

Another question comes up which has been referred to by Dr. Adair. Sometimes in healthy individuals we find diphtheria bacilli.

We find various types upon which we have spent considerable time in the laboratory of the State Board of Health, and there are certain types which we have come to look upon as associated more particularly with clinical diphtheria and we regard them as more or less diagnostic.

There are two other groups which are more frequently found in throats of the healthy than the group which I have mentioned.

These are perhaps less frequently found in clinical cases than is the first group. Therefore, we have three groups: one group found *par excellence* in clinical cases; the second and third groups, particularly the third, found in the respiratory passages, particularly in the nose, of healthy individuals. These do little harm, and perhaps we may, except under certain conditions, lose sight of them without any very great harm. It is the first group to which our attention is called. But the fact that Dr. Adair has pointed out, that well people may sometimes harbor diphtheria bacilli is an important one. Are there groups of well people who do harbor these more than other people? There are. Such people, I think we are in a position to say, particularly when the bacillus is found in the throat, have usually been exposed recently to clinical diphtheria. That being the case, we must take some recognition of them. I am not prepared to go into the question of stating exactly upon what types of bacilli quarantine should be established or maintained. I think that the presence of diphtheria bacilli must be recognized as diagnostic where we have a history that shows that the person in whose throat the bacilli have been found was recently in contact with diphtheria cases.

This brings us to the point of how diphtheria is spread. While we forget that diphtheria bacilli may resist drying for months, perhaps, we also know that the dried bacillus on cloths is not so frequently the cause of diphtheria as we are perhaps inclined to believe it is. I do not mean by this that I would recommend handkerchiefs, clothes, or other things impregnated with diphtheria bacilli for the use of one who is not suffering from diphtheria, but I believe that perhaps there is another feature that we should recognize as being more important in the spread of diphtheria, and that is direct throat to throat, nose to nose, person to person infection. We have noted this in the board of health work, and when one watches children at play or school and sees the freedom with which they blow the same horn, chew the same gum, and do other things of this kind, one sees numerous opportunities for the spreading of germ contents of the mouth. We may thus have diphtheria bacilli, doing perhaps little harm in the nose or throat of their host, but capable of being passed on to some other person where they may do much harm. I think this leads us to understand how epidemics apparently arise sporadically where we least expect them. You will notice that the diphtheria bacillus does its work usually in the early winter months, after school children are brought together, where it has the very best opportunity; that is, in the exchange of contents of the respi-

ratory passages. That, I believe, is more responsible for epidemics than any other means I have referred to. You will remember that the diphtheria bacillus dies out in ordinary cultures. Sometimes we fail to find diphtheria in a swab when it is sent a long distance, while if we ask and receive a second specimen sent in the usual way, *i. e.*, by inoculation of the culture medium by the physician, we are often able to show diphtheria bacillus in some cases in which at first we could not find it. I think it is for you who, in various parts of the state, have to administer the present quarantine regulations, and who see the difficulties in doing so—it is for you to suggest how these may be modified; and it is in order that we may together have a clear understanding of these matters that I speak this morning. I shall be very glad to hear from the people throughout this state who have to carry into effect these various duties. I would like to hear, if possible, of some cases in which there was misunderstanding, that we may find the source of error. I think that we can improve conditions and know more about it, at least, if we get frequent specimens from the same case. Where we diagnose diphtheria for local boards of health we should have opportunity for examining specimens from each case frequently thereafter. This might save the patient several days of quarantine.

Again, when we send out a negative report, and the health officer or attending physician has it in mind that it is still a case of diphtheria, as shown by clinical evidences, the State Board of Health wishes that this doctor or health officer should send another specimen and say frankly that he still thinks it is diphtheria, that we may again examine several specimens until we are convinced that the bacillus is not there. Sometimes continued negative findings have occurred, but usually the second or third specimen has shown diphtheria bacillus. There are many reasons why these negative reports may be made from the laboratory, which I will not state now. They are all told on the back of the report blank issued by the board. If a report is not what you think it should be; if there is any misunderstanding, please give us another opportunity. We are all studying. We want to learn as much of the clinical conditions, and you want to learn as much of the bacteriological conditions, as possible.

Dr. Hutchinson: This subject is of great importance and is deeply interesting. The discussion is now open. We will be very glad to hear from every one who feels inclined to speak upon this topic.

Dr. Bayley (Lake City): I wish to say that I have found the report of the laboratory verifying a diagnosis of diphtheria after the membrane has disappeared. The opinion was prevalent among the people that when the membrane has disappeared the danger of contagion has passed. Now you simply can tell the family that the germs remain after the membrane has been shed and that they must remain in quarantine until you can get a negative report as to the presence of the bacillus. This is of great assistance to health officers in handling the quarantine of diphtheria. From experience in our section of the country I think it is difficult to get an epidemic of diphtheria. Diphtheria does not seem to flourish well in Lake City, nor are we apt to get it back in the country. Among the Germans it is hard to maintain proper quarantine. The families visit back and forth early and do not see the necessity of maintaining quarantine.

As to whether quarantine is of assistance in preventing the spread of the disease, I think it certainly is. Last spring we had a case of diphtheria in an adult unquarantined until within a few hours of death. From that case came three or four other cases of diphtheria. Now, that is the only instance in the time that I have had charge of the health work that I have had the disease spread from a case of diphtheria. All the other cases, however, have been under quarantine from the outset.

Dr. Adams (Rochester): I appreciate the discussion. While I believe the teachings of the laboratory are invaluable, I do not believe that physicians should put out of their minds the clinical appearance of this disease. I believe they should keep in touch and understand this work, and I believe that the young medical men who are now being educated will appreciate as they enter into active work that it is difficult to bear the responsibility which has been thrust upon them without the aid of laboratory findings. There are times when it is impossible to communicate with the state laboratory quick enough, and for this reason a man should be able to make his own cultures and should be able to make his own preliminary examinations. With the state laboratory back of him, with its able director, he can then carry out the work efficiently. We must each of us qualify and understand this work, so that we can enter into it and make our own bacteriological examinations.

Dr. Haggard (Minneapolis): Following the previous description of the typical diphtheritic membrane, I would like to describe a membrane rather frequently seen and differing widely from the other. It consists of one or more irregular patches of dull whitish

color—marbled spots—underneath the smooth, glistening surface of the tonsil or palate. There is moderate or little swelling and but little redness at the edges. It is very persistent and resistant; it often extends slowly and regularly in unfavorable cases in all directions or by multiple foci. Its final disappearance is by equally slow absorption. Belonging to the true diphtheritic lesions, these are of great importance compared with another form which I briefly allude to as follows: In cases of sudden development with glandular swelling, like parotitis, we sometimes find a membrane of very rapid development; very thick, with abrupt edges; semi-transparent, tough and firm, and this, when shed, is cast off in one mass, leaving a surface but little damaged, yet raw and sanious.

I am glad to have heard the remarks of Dr. Adair upon diphtheritic paralysis. Some experiences of my own confirm his statement.

As to the presence or absence of the Klebs Loeffler bacillus, its detection in the hands of those far removed from the state laboratory is of very great importance. It seems to me that a simplified method enabling us to examine our own smears would often save us anxiety and blame. It might be within the scope of the State Board of Health to supply to those in far parts, and to all who wished, some information or outline of such work.

Dr. Nippert (Minneapolis): I have been much interested in this discussion. Dr. Adair has given a very artistic description of the characteristic membrane, but we do not always find it so. I believe its appearance in epidemics is more apt to be characteristic than in sporadic cases. In my experience, vomiting or nausea is almost as frequent at the outset of this disease as it is in scarlet fever. In coping with diphtheria we have three points to consider:

First, a prompt and positive diagnosis. In this we are greatly aided by the bacteriological examination. The present state of our knowledge of the nature of diphtheria is that it is an infection caused by the Klebs Loeffler bacillus. Cases of sore throat resembling diphtheria may not show bacilli. We would hardly be justified in quarantining such patients. If bacilli are found, even if the clinical appearance of the spots in the throat is not that of diphtheria, the diagnosis is certain, and quarantine should be established.

Second, the arrest of the disease by the prompt use of antitoxin.

Third, the isolation of the patient until the bacilli have disappeared from the throat. In my experience, diphtheria is not easily carried by a third person, but it is often spread by those who have it in a light form. Such children may go to school while ill with the disease.

Methodical inspection of the throats of the school children is one of the most efficient preventatives to the spread of the disease.

Dr. Hall, the Commissioner of Health for Minneapolis, was called upon.

Dr. Hall: I would like to say something more regarding the quarantine of the disease. I believe thoroughly that you will never control diphtheria until the bulk of physicians make use of bacteriological examinations for the purpose of diagnosis. I can state that in Minneapolis probably not one-fifth of the physicians in the city ever use culture tubes, depending entirely upon clinical diagnosis. It is also a fact that the mild cases are the ones that spread the disease. If in cases of ordinary sore throat that physicians are called upon to prescribe for, they would take a culture from the throat and send it to the laboratory so that the early quarantining of cases of diphtheria could be made, one-half the fight against an epidemic would be gained.

There is another important fact, viz: the use of antitoxin for immunizing children and those who are exposed. You may carefully isolate your patient. In a few days his throat is clear. It is hard to persuade the family that the patient is not entirely well, hence he is not kept carefully isolated. I have one case in particular in mind, under Dr. ——'s care. The membrane cleared up, but the people were cautioned to keep the child isolated. The bacillus did not clear up very rapidly; the child was allowed to communicate with other members of the family; several other cases resulted from this negligence, with one death.

Part of the difficulty in clearing up cases of diphtheria lies, I think, in the physician, especially those who think the laboratory is a good deal of fudge. They are quite apt to be good fellows, etc. With that sort of sentiment expressed by the family physician, you can readily see how the family will allow the well children to mingle with those ill.

Dr. Bracken: I am glad to have heard this question of quarantine for diphtheria so thoroughly discussed. The necessity of still continuing quarantine after the disappearance of the membrane is important. This question frequently comes to me in correspondence, and while antitoxin has been a great help to us in the way of reducing mortality from diphtheria, in a way it has tended to increase the possibility of exposure to diphtheria, for under the old treatment the membrane would remain for a considerable period, while under antitoxin treatment the membrane may clear up in a few hours. It is a common idea that with the disappearance of the

membrane the patient is well. Possibly that is true, speaking in a relative sense. The patient is out of danger, but physicians should bear in mind that the use of antitoxin does not destroy the bacilli that are present in the nose and throat of the patient, and they should further bear in mind that quarantine is not for the benefit of the patient, but is for the benefit of the community.

Dr. Head (Minneapolis): I wish to emphasize one of the remarks made by Dr. Hall. The object of this conference, I understand, is prevention of disease, and we know that in antitoxin we have an efficient remedy not only for the treatment of diphtheria, but also in its prevention. Again and again the general practitioner has the opportunity of observing the great value of antitoxin in the prevention of diphtheria, especially among the families of the poor, where there are a large number of children in a family and one child comes down with diphtheria. There is no means of isolating the child in the home when all are living in one or two rooms. If the healthy children are given an immunizing dose of antitoxin, very rarely do any of them come down with the disease. But how long will we wait before we apply this as a general law, and whenever diphtheria breaks out require that immunizing doses of antitoxin be given to all children that may by any possibility be exposed to the disease. I have seriously contemplated in private practice, when next an epidemic of diphtheria occurs in this city, notifying all of my private families by postal card, stating that an epidemic of diphtheria exists and that I would advise the immunizing of all children attending school by injecting them with a dose of antitoxin. Would this not be a proper and wise method of procedure? Ought we not to take measures to supply pure antitoxin in large enough quantities to immunize school children whenever an epidemic of diphtheria exists in a community?

Dr. Hall: Just one other remark in regard to releasing the quarantine. We have been experimenting with the use of formaldehyde. With its use in disinfecting the sick-room of a diphtheritic patient, moving the patient for the time being into an adjoining room, the germs will clear up from the throat much faster than without such systematic disinfection of the room. It has been tried in some of the institutions in the city, and with remarkable results and no secondary cases.

Dr. Hutchinson: The time allotted to this discussion has expired, and we will call on Dr. Adair to close.

Dr. Adair: Mr. Chairman, I have been very much interested in the remarks made by members of this conference. It is a fact, and

one which I wish to reiterate, that it is exceedingly difficult to dislodge bacilli from either the throat or nose of diphtheria patients. It is also a fact that the disappearance of the membrane is absolutely no guide in forming a conclusion as to the amount of infection remaining in the throat of a diphtheria convalescent. Dr. Hall's remarks with reference to the use of formaldehyde leads me to say that in the course of some investigations in this direction, carried on a few years ago, and in which a variety of therapeutic agents were used, such as bichloride of mercury in the strength of one to five hundred, potassium permanganate, carbolic acid, sodium, hydrogen dioxide, Loeffler's solution, and others; I obtained the best results from the use of a *one-half* of one per cent solution of formaldehyde sprayed into the throat and nose. I do not think you can use it long in that strength, however. You can use it for a few days, but if it is continued it is apt to excite too much irritation of the tissues. However, it does more to clear out the parts than anything I ever employed.

As to the matter of quarantine and the length of time it should be observed: my rule is to confine diphtheria patients to bed for four weeks after the subsidence of acute symptoms and the disappearance of the membrane, and during that time the throat is sprayed out daily with one of the above mentioned solutions. This I believe to be a precautionary measure always to be observed because of the liability to sudden death from the impaired heart. One or two experiences which I have unfortunately had with children going to the water closet and falling dead on the way back to their room has convinced me as nothing else could of the importance of this. If this point were impressed upon the family, that the child is being kept in bed and quarantined, not on account of danger to the community or others, but because it is a dangerous thing for that child to be on his feet for several weeks, even in the mildest cases, the hostility so often encountered in private practice to the enforcement of the necessary quarantine measures would in a large measure be obviated, I am sure. And certainly when the child does get up, he will have a stronger heart and will not be so apt to infect others.

Dr. Hutchinson: The next topic is Rabies, opened by Dr. Sweeney, of St. Paul.

Dr. Sweeney: Mr. President and Gentlemen, it is rather unfortunate at the outset of discussion of rabies that we have to consider seriously the question of the existence of the disease itself. It is a menace which has had its existence in all ages and countries.

At the same time the reality of the existence of the disease is doubted. In every country there are some men who are perhaps guided more by superstition or lack of reason than by scientific research, hence in dealing with rabies we are confronted by positive assertions on the part of some that the disease does not exist. It is very difficult to account for this. We must not forget that in rabies man's beloved animal is attacked, and wherever sentiment comes in to clash with reason, reason gets the worst of it. People are prone to believe what they want to believe, so that in considering this denial of the existence of rabies, we have to simply regard those making such denial as people who are guided by their emotions and affections rather than by the dictates of reason. This feeling is grounded upon a general ignorance of the disease. It is a rare disease. It is very little seen. It is very often not recognized. Doctors see people who immediately following a bite from a dog will bark and bite and perform other grotesque actions. The newspaper reporter hears of such a case and it is exploited for the entertainment of the public as a case of hydrophobia. The novel which we read speaks of the dog rushing down the street, frothing at the mouth. The newspaper speaks of hydrophobia or rabies as being a hot weather disease in which the dog refuses water, froths at the mouth and rushes madly at everybody. In fact the general description of the disease in books and newspapers has been misleading. Not less misleading has been the description of the disease in medical text books. If you take the trouble to look up the literature on the subject, especially that published eight to fifteen years ago, the chief features of the disease are held to be mental excitement, fear and general distress. The patient is described as being held upon the bed, praying for death, asking to be restrained from biting friends, falling into convulsions at the sight of water or at the sound of loud noise, barking like a dog, going through grotesque antics. A description of that kind is absolutely incorrect and misleading. It has no basis in fact. Those who have seen clinical cases of rabies find the conditions quite the opposite. The condition of excitement is not marked. The patient is in condition of mild delirium from which he can be aroused at any time by a sharp voice. He can carry on a conversation, lapsing again into a condition of quiet muttering as long as he is undisturbed. The symptoms which are characteristic of the disease are very few and can be summed up rapidly. The first one is pain, which comes on a day or two before the onset of the disease. It is rheumatic, not steady, but sharp and shooting. The second is insomnia, which

is unlike anything I have ever seen, in that it is absolute and total. The patient at all times, night and day, is bright eyed, wide awake and ready to see things. The insomnia is complete and all narcotics, except morphine, fail to relieve it. Deglutition is affected. It can be compared to nothing except to the rapid spasmodic inspiration that one sees when a person is suddenly showered by a pail of cold water. There are rapid series of inspiratory efforts, sometimes accompanied by a noise whenever the attempt is made to swallow water. It is a spasm of the respiratory muscles. The muscles of deglutition are not involved in the spasm, but only the diaphragm and costal muscles. The temperature is low, 99, 100 and 100½,—a very insignificant temperature. The pulse is very bounding at first, and subsequently rapid. Convulsions come late in the disease. They are general, tonic and clonic, as in epilepsy. Following the onset of convulsions is apparent improvement: The patient can swallow better on the third day than on the first. The family and perhaps the physician will say he is better because he can swallow. But the respiratory spasm is absent only through weakness and loss of power over the entire body. Spasm has been diminished because paralysis is setting in.

In regard to the extent of the disease there was so far as I can find no evidence of rabies in man or animals in this state prior to 1894. I understood from Dr. Hewitt that in 1890 a brief outbreak in animals alone occurred, but in 1894 the first case was recognized in a human being and from that time up to 1900 there have been occasional outcroppings. In the first case a dog bit three people, two of whom died from rabies, and the other was sent to the Pasteur institute and is still alive. In the third case, two years later, three children were bitten by the same dog. Two died, one was sent to the Pasteur institute and is still alive. The others were isolated cases. The diagnosis in four of these cases was settled by laboratory methods, by transmission of the disease to rabbits in varying series. In human beings in St. Paul there have been seven deaths. There have been a large number of cases of rabies in animals. Dr. Price, to whom we are all indebted for work relating to this disease, has estimated that probably 250 dogs have been proven to have rabies, both clinically and experimentally, during the past five years in St. Paul. Dr. Wesbrook has experimentally determined the existence of fifty cases of rabies, sent to him from various portions of the state, including one human being. We must bear in mind that the official records of rabies may be misleading for the reason, that so far as animals are concerned rabies

is not often detected. There are two forms; the dumb rabies and the furious rabies. When a dog has the dumb variety of disease he simply crawls away under a barn or into the woods and dies. We know that for every dog that has been demonstrated to have the disease there are probably one-half dozen or more that have been bitten and will later develop the disease. In fact, it is impossible to estimate how widespread the disease is in the state on account of the carelessness of observers and the tendency of dogs to wander away. In furious rabies dogs will wander for miles throughout the country, snapping at various animals, bitting other dogs, who take the disease and spread destruction far and wide. The laboratory figures must be very much increased if we wish to get at an approximate idea of facts. The Bureau of Animal Industry gives a total of 143 deaths in 1890 in human beings throughout the United States. In 1900 the figures for the entire United States were not obtainable, but there were 230 deaths from hydrophobia of human beings in seventy-three cities. Of that number sixty-eight were in Chicago and twenty-seven in New York. It is, of course, not wise nor accurate to quote the statistics of the various Pasteur institutions, but we can have an approximate idea of the extent of disease by showing the number of people bitten by animals proven to have rabies. The Chicago laboratory treated in ten years 449 individuals who had been bitten by animals, tested by the laboratory and found to have the disease. In that same period they treated 505 people who were bitten by animals which showed symptoms of rabies. The Pasteur institute of New York in ten years up to 1900 treated 447 known to have rabies by the laboratory method and treated 268 people bitten, upon clinical symptoms of animals. These figures are suggestive in that they show a decided and marked increase in the spread of rabies throughout the country.

As practical sanitarians, the question which interests you, is what can be done to prevent the spread of rabies? There is no disease, so far as my knowledge extends, which can be so easily and thoroughly stamped out as rabies. It is perfectly preventable. There are two or three methods by which this can be done. The first is the destruction of all stray dogs. Fifty per cent of the dogs in the United States are stray dogs. All other dogs should be licensed and muzzled, and any dog found unmuzzled upon the street should be killed as possessing no owner. The licensing of dogs is also advised because by that method we can tell what dogs are stray and what dogs are in the keeping of owners. To show

what can be done we only have to look at the history of European countries. In 1875 there was a considerable epidemic of rabies in Belgium and from sixty to eighty deaths per annum. In two years rabies was stamped out by the muzzling of dogs, and deaths from this disease ceased.

In Germany prior to '85 there was an average of sixty deaths per annum. In six years this death rate had ceased, due to the muzzling law. In Holland, rabies was always epidemic up to 1870. The muzzling law in four years stamped out the disease. In Sweden, before 1870, there were ten deaths per annum of human beings from rabies. The enforcement of the muzzling law has prevented any deaths from that time to this. The experience of London is perhaps most remarkable. There, there was prior to 1870 a death rate of from sixty to 110 per annum. The second year following the muzzling law deaths from rabies had entirely ceased. After five years the muzzling law was repealed. In the course of two years after that another epidemic began and deaths became more frequent, but the muzzling law was re-enacted and now rabies is practically unknown. I do not know, in thinking over this subject, what prevents us from succeeding in enacting a sanitary law in regard to rabies in this country. There is one thing that sticks out plainly. We can never extinguish rabies in this state until we pass a rigid muzzling law and we will never pass a law that is worth passing until we have educated public sentiment to a recognition of the existence of the disease; to a recognition of the destruction that it does upon the cattle of the country, and to a recognition of the danger that there exists to human beings in the state. The first step is education of the people in the recognition of the disease; in the fact that it exists; and in methods by which it ought to be and can be stamped out

Dr. Hutchinson: We have with us to-day Dr. Foster, state veterinarian of South Dakota. We would like to hear from him.

Dr. Foster: I do not think that we have ever had a case of rabies in our state. I have not heard of it.

Dr. Hutchinson called on Dr. J. N. Gould, of Worthington, Minn.

Dr. Gould: I am not very well posted on this subject. Among animals in the southwestern part of the state we have frequent outbreaks of rabies. They are not very extensive though. A few years ago there was an extensive outbreak among sheep, cattle and dogs in the western part of Nobles county and in Rock county. In those outbreaks there were no people bitten that I know of, at least none reported. I have been able to recognize

it in other small outbreaks caused by stray dogs. A few cattle and horses were bitten. There has been none near Worthington within the last two or three years at least.

Dr. S. D. Brimhall was called upon.

Dr. Brimhall: It has been my experience in this state within the last four years especially, to find the disease widely scattered in nearly all of the southern part of the state; also in the western part. In 1897 we had quite a serious outbreak in Wright county. There a stray dog passed through the county and bit a dog belonging on a farm and in a few weeks the disease developed in this dog. It bit a number of cattle and hogs, also a child, but in this case through the clothing. A number of cattle and hogs were killed.

We have had a number of outbreaks in other sections and undoubtedly there has been more than we have knowledge of. We often hear of the disease accidentally. This year we have had, so far as we were able to learn, outbreaks in eight different counties. Cattle and occasionally a hog or sheep have been affected. In the city of Minneapolis I think there has only been one case of a horse dying this year from rabies.

But it surely is a serious matter even from the animal standpoint, because there are each year a number of valuable animals killed by the disease. I should like very much to see a law enacted that would compel the muzzling of dogs.

Dr. Hall: In Minneapolis this year we have had an increase of the disease among animals. One person recently died on the east side of the river of rabies. Since then there was such a constant scare that I tried to have an ordinance introduced requiring the muzzling of all dogs. The ordinance that was in existence gave me the power of promulgating such an order, but it was simply discretionary with the mayor. I tried to get an ordinance requiring the muzzling of all dogs, but I ran up against this foolish antagonistic sentiment of the people. I thoroughly believe that the muzzling of all dogs is absolutely necessary, especially in crowded communities. If we can discourage public sentiment we will do an inestimable good.

Dr. Cool: I do not know that I can add anything to this subject. I have had very little experience with it. We have had one death since I lived in Faribault, supposedly from hydrophobia. The clinical symptoms were almost identical with those described by Dr. Sweeney. There was some question as to its being hydrophobia because there was no attempt to bite parties. The patient

died in convulsions, but there was no scientific investigation of the remains. The case was that of a policeman. A suspicious dog was on the street and the policeman undertook to drive him away; the dog turned upon him, the policeman grabbed him and was bitten in his hand. The wound was cauterized. In about six weeks the patient developed hydrophobia and died. I think this is the only case that has occurred in Faribault since I lived there.

Dr. Wesbrook: I wish to emphasize the points brought out by Dr. Sweeney and referred to by the later speakers, Dr. Hall and Dr. Brimhall. In the first place we have to recognize the fact that rabies does exist in this state. The red spots on this (map shown) may indicate that we had a case of rabies at every spot in that locality as evidenced by laboratory findings. The larger red spots represent two cases, and the still larger ones represent any number of cases. The blue spots represent cases which were probably rabies, but in which the specimen as sent us was so contaminated through delay that it was impossible to tell the inoculated animals dying with meningitis before it was possible for the development of rabies. We have examined seventy cases from twenty-eight different localities. In forty-five of these we have rendered a diagnosis of rabies of which we are absolutely sure. A number of others would probably bring this up to fifty. These cases include cows, horses, sheep, pigs, one wolf, and possibly two skunks, although these latter never were sent us. They also include fifteen human beings, two of whom died, which I probably should have mentioned first.

Recognizing then that rabies does exist in this state, what can we do? In one case in which no laboratory examination was made, which occurred two years ago in this state, it is known that many cows were bitten by one dog, and that sixty-five of them developed symptoms of rabies and died. It is extremely difficult to trace the cases we hear of. There are animals undoubtedly bitten in which no history of the bite can be obtained. Many cases have occurred in all parts of the state which were not recognized. There were other animals which were bitten and animals which were infected later from those cases which we investigated. This increases the number as has been stated by Dr. Sweeney.

What to do? I think Dr. Sweeney has pointed this out when he says that we should have a tax and muzzle on all dogs, and that all not taxed and muzzled should be destroyed. Possibly if the tax was made large enough there would be more stray dogs, and more dogs that could be destroyed. The difficulty would be in the de-

struction of stray dogs. They must be destroyed and must be destroyed both winter and summer—all the year around. The dog catcher should be always with us.

I think I have nothing further to say, except upon the matter of the presence of rabies virus in cows' milk. In one case we demonstrated that the milk of a rabid cow contained the virus of rabies five days after having been drawn. The persons who drank of this milk are still all right. Probably there was little danger from this milk. I believe that the milk is not likely to be very abundant during the development of rabies in a cow.

Dr. Hutchinson then called on Dr. Sweeney to close the discussion.

Dr. Sweeney: I have almost nothing to say but express my satisfaction that this subject has been considered thus seriously. There has only one thing occurred to me during the discussion: Is the suppression of rabies difficult? Every poor man loves a dog and some love two, and he loves his dog better than he loves other people's children. The matter cannot be handled by an ordinance which will be enforced six weeks and then allowed to become a dead letter. There must be a proper education of the public to the actual dangers both from the character of the disease and from a financial point of view. I think that if this sanitary conference results in bringing about a permanent organization its chief duty should be to instruct the people of dangers which menace them. After the people are properly educated they will take steps to secure the proper remedies.

Dr. Hutchinson: The next topic on the programme is Smallpox and the subject will be opened by Dr. Bracken.

Dr. Bracken: I think probably before I open this subject action should be taken on one or two matters. It would be well to determine the time of meeting for this afternoon. As we have but one subject for the afternoon and the rest of the meeting will be given up largely to business I think there is no reason to hurry matters. The one subject, however, will be of interest to all. I move that the hour for the afternoon session be set for three o'clock.

Motion was seconded and carried.

Dr. Bracken: Again, Mr. President, yesterday resolutions were placed in my hand as bearing upon the creation of a national board of health and it was suggested that I should present them at some time during the progress of the conference. A national board of health is a necessity. Most of the countries that are advanced in

sanitary matters have national boards of health. In this country we have a Marine Hospital Service that has been doing to a great extent the work of a national board of health. It was not originally created for sanitary purposes, but its authority was extended first to maratime quarantine and then gradually extended along other lines so that now it is practically performing the function of a board of health. A bill has been presented to the Senate and House looking to a still further extension of power to this Marine Hospital Service, making it in name as well as in fact a national board of health. I am certainly in sympathy with such action. We can accomplish more with such an organization. The resolutions I am asked to present read as follows:

"*Resolved*, That it is the opinion of this body, which is assembled under the name of the Minnesota Sanitary Conference, that the interests of the public health require as an addition to the machinery of our national government a Department of Hygiene, with a Minister of Public Health in the Cabinet of the President, said department to have charge of all matters pertaining to public sanitation and hygiene in the United States of America, as well as a general supervision over matters pertaining to medical education and the issuing of licenses to practice medicine in any of the states or territories of the United States.

"*Further Resolved*, That pending such a radical change in our national govenment, this conference desires to express its approval of and to endorse the bill, S. 2162, introduced by Mr. Perkins at the first session of the Fifty-seventh Congress, entitled: A Bill to Increase the Efficiency and Change the Name of the United States Marine Hospital Service.

"*Further Resolved*, That a copy of these resolutions be forwarded to the Congressmen and Senators representing the State of Minnesota."

I trust you will take action upon these resolutions.

It was moved, seconded and carried that the resolutions be adopted.

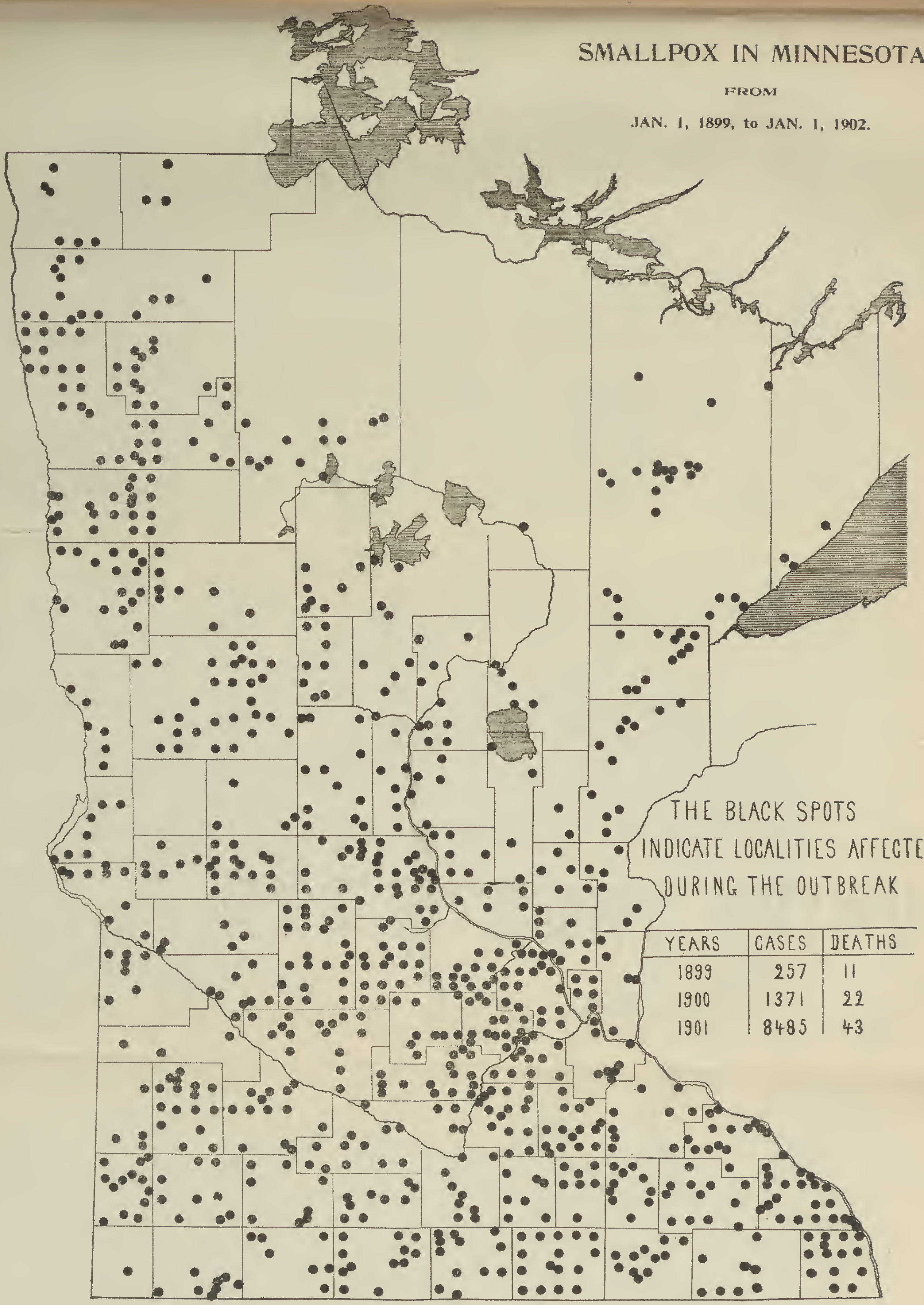
Dr. Bracken: Mr. President and gentlemen, it is hard to know where to begin discussion upon the present epidemic of smallpox. That it has been with us during the last three years 1899, 1900 and 1901, is plainly shown by the map, which represents the places where it has occurred:

In 1899 there were 257 cases .... 11 deaths
In 1900 there were 1,371 cases .... 22 deaths
In 1901 there were 8,485 cases .... 43 deaths

SMALLPOX IN MINNESOTA

FROM

JAN. 1, 1899, to JAN. 1, 1902.



YEARS	CASES	DEATHS
1899	257	11
1900	1371	22
1901	8485	43

You see the number of cases have been on the increase. The number of deaths have not increased in the same ratio as have the number of cases.

The present smallpox is exceedingly mild in type. Vaccination will prevent it. No one who has made a careful study of the present conditions will dispute these statements for a moment. Many say they would rather have smallpox at the present time than be vaccinated. If you look simply at the personal inconvenience I do not know but that this is a practical statement. But if you look at the same proposition in another light, no one but a selfish individual would make such a statement. To be vaccinated causes very little inconvenience. To have a case of smallpox is demoralizing. It affects not the individual alone; it affects the family and the entire community. We have all grades of smallpox: cases where there are only three or four pustules, and cases where the body is thoroughly covered. The mild cases are just as liable to give rise to the severe type as are the severe cases; so we have to be as careful with the mild as with the severe cases. At the beginning of the epidemic we had much trouble in persuading many that the disease was smallpox. They reasoned negatively rather than positively. It is a poor way of reasoning. If any doubting physician had taken as much pains to determine from his book knowledge that the disease might be smallpox as he took to determine the contrary he would have reached an affirmative quite as readily as the negative decision which so many have accepted. In diphtheria the diagnosis is not difficult in the cases that die. It is the mild cases that worry us. So it is with scarlet fever, and so it is with smallpox. I presume the history of smallpox at the present time is unique. The disease prevails all over the United States. It is just as bad in other states as in Minnesota. When it first appeared in this state I supposed it would soon change its character, but up to the present time it has not done so. The time undoubtedly will come, however, when it will change to a more severe type.

The question has often been raised as to where the disease came from, and it has been stated that it came from the Philippines. It did not do any such a thing. It was in the southern part of the United States in '95. It probably came from Cuba, through Cuban refugees, before the Spanish war broke out. From the eastern southern states it spread to the western southern states even to the Pacific coast. It came into this state from different sources. First from Nebraska (and the Nebraska infection was

from the south). Second, along the lines of the Great Northern and Northern Pacific railroads from Washington. Third, from Texas. The case from Nebraska was a very mild one, but the infection from this man caused the death of his wife and the attending physician. In the case from the Texas exposure the patient was not very ill. The washing from that patient was sent to the laundry. The laundry girls came down with what was diagnosed as chickenpox, and the laundry girls' brother came down later with what was recognized as smallpox, the infection coming from his sisters.

A word about chickenpox and smallpox. Many will tell you it is easy to make a differential diagnosis. Many will lay down absolute differential rules. There are many plain cases of smallpox that any physician can diagnose. There are cases where it is very difficult indeed to make an absolute diagnosis as between chickenpox and smallpox. There have been cases of smallpox diagnosed as chickenpox in this state during the past year by experts. I remember one family in particular. The children were taken ill and the attending physician appealed to me. I sent a capable physician to investigate and he reported the disease as chickenpox. About a week or ten days later the first physician came again and said the children's mother was sick and that he did not believe she had chickenpox. The same expert was sent again and he reported the mother ill with smallpox contracted from the children. I do not believe that these are one and the same disease. On the other hand, I do think we must recognize the fact that it is not always an easy thing to make a diagnosis between chickenpox and smallpox, and that where there is any doubt the public should have the benefit of that doubt. It does no harm to quarantine chickenpox and this error had better be made than the reverse.

Now I want to say just a few words about vaccination. We hear a great deal on the street about what cannot be done and what can be done, and hear many people say they will not be vaccinated, but it is amusing to see how, when a case of smallpox appears in a community, the people are all after their doctors within half an hour to be vaccinated. They may have said lots of things before the case appeared, but now they want the protection that vaccination will give them.

The question of handling smallpox is sometimes most exasperating. At times I feel like saying, let us throw up our hands and let every person who is foolish enough to neglect vaccination have smallpox. Just imagine those in authority undertaking such a

thing. Imagine the health officer of Minneapolis saying to the people that are opposing him, all right, I will not quarantine a case of smallpox, but will let you have all you want. They would turn around and be just as energetic on the other side, criticising him for not doing his duty. I was at Winnipeg last summer and heard a physician say that it ought to be considered a criminal offense for a person to have smallpox nowadays. There is no excuse for the continuance of this disease. The sooner that fact is recognized the sooner we will get rid of it. The records for our state show a great many cases. I feel that in a way we have reason to be proud in having so complete a record, but I do not want the impression to go out that we have a larger proportion of cases than neighboring states. It is a hard problem to suppress this epidemic so long as the disease is of the mild type. Let a single death occur and people change their sentiments in a hurry. They are then ready to say, we don't want any more of it.

Often in public places we hear business men poo-hoo the doctors' diagnosis and say the disease is not smallpox. Offer to take these same men out to see a case. They will not want to go. Yet they are perfectly willing to contradict the physicians' diagnosis.

Dr. Healy, Superintendent of the State Board of Health of North Dakota, was called for.

Dr. Healy: We have smallpox in North Dakota. We have not near as large a number of cases, perhaps, as you have in Minnesota, but we have as large a proportion considering the population. Up to last spring we had very few cases. Last spring we had it in a number of places, all apparently at once. We attributed it to the breaking up of lumber camps. Through the summer months the disease seemed to subside very markedly. Later, this fall, it began to increase, and during the last two months, especially during the last six weeks, it has increased very rapidly. I think I have noticed that the severity of the disease is also increasing. I have seen some very bad cases recently. We have not had many deaths. In one family, I remember in particular, we had two deaths, and two other patients were very ill and nearly died. Our state board is not able to do as efficient work as is done here in Minnesota. We have no funds to carry on the work, and I sometimes have been quite discouraged. It is almost an impossibility to educate the people up to vaccination, excepting when smallpox breaks out in a neighborhood, and then they are frightened indeed. Quarantine, of course, is very expensive, and is really a serious proposition. Sometimes I have wondered whether our quarantine

is really going to stamp out the disease. I have felt once or twice like Dr. Bracken, when he speaks of throwing up his hands and allowing people to have their sweet will. I feel like notifying friends and relatives that after a certain period I will do nothing more.

Dr. Hutchinson called on Dr. Edwards, President of the State Board of Health of South Dakota.

Dr. Edwards: It appears that we all have about the same experience with this epidemic of smallpox. We had it in South Dakota and are not entirely rid of it yet, but the difficulties attending the quarantine, vaccination, etc., were great. In our state, I think we have more difficulty due to mischief-making doctors, perhaps, than from any other one source. A health officer makes a diagnosis of smallpox in a family: some physician off at one side throws out the hint that he does not believe it is smallpox. Well, there are plenty to believe that, and it is published about. This same mischief-making doctor may then go to a case and he calls it winter rash, or Cuban itch; if it is in the summer season he calls it summer rash. In our state a physician early in the spring diagnosed his cases as winter rash. When the hot weather set in he still had cases of it, and it was summer rash. These people that want to oppose everybody else, obnoxious individuals, will find a way out. In one instance a physician diagnosed everything as chickenpox, and insisted upon it. The board of health could not induce him to change his diagnosis. We were satisfied that he knew better but did not have the moral courage to admit that he was wrong. He was a health officer himself, and that complicated the situation. We finally compromised by allowing him to call it what he saw fit, but he was to quarantine. This he agreed to do.

Dr. Jencks (Pipestone): We have quarantined 126 smallpox patients in a town of about 3,000 inhabitants. The great trouble that I had to contend with was the concealment of cases. I think at least 60 per cent of cases I quarantined were first reported to me in an indirect way; the cases, on investigation, proving to be smallpox. Last week I quarantined a case of smallpox where four in the family had the disease. As Dr. Bracken remarked, a great many of our people say, well, if it is smallpox, let us have it and get over it. There is one thing I want to ask: Is this very mild form of smallpox protective? There is one point upon which I am thoroughly satisfied, and that is that vaccination does protect against smallpox. I do not know of a single case that I have had where the patient had been previously successfully vaccinated. There

was one case that may be of some interest. The lady was taken with the usual symptoms of smallpox—headache, backache, temperature 104 degrees to 105 degrees. She was pregnant and gave birth to a child at about the eighth month. The child was covered from head to foot with marks that looked like smallpox and had all the characteristics of smallpox eruption.

Dr. Adams (Rochester): In this connection I only want to add a few remarks. We are all agreed that there is only one means of prevention against smallpox, and that is vaccination. We are also agreed that the material for vaccination is not always reliable. It has been my experience to vaccinate 500 people and have to repeat my work. While this produces a feeling of dissatisfaction, it will be all right providing your city attorney does not interfere to negative your efforts. If you could quarantine your city attorney about this time you might obtain universal vaccination, but about this time some one will express the opinion that unless there is an epidemic it is not necessary to vaccinate. It was suggested to me last evening that if the vaccine could be kept at one temperature—at 50 degrees—from the time it left the laboratory until the time you receive it, it would be a great help toward having it uniform. I know that if it reaches 70 or 80 degrees it is usually destroyed. This fact should be impressed upon physicians everywhere, and more uniform results could then be obtained. In Rochester the cases that occurred after we had vaccinated thoroughly our school children were only among adults—those who had refused or neglected to be vaccinated. There was one person who distributed anti-vaccination literature and took pains to send letters to individuals, and she made quite an impression. I succeeded in having some photographs taken by Dr. Smith of one of our worst cases of confluent smallpox, and when any question arose as to whether it was really desirable to be vaccinated the photograph was shown. It had an excellent influence. A case of this kind in a neighborhood is a good thing—it helps us out.

Dr. Bayley (Lake City): I have a couple of photographs that have assisted me greatly. One was that of a boy about fourteen years old, who showed the disease markedly. But the one that comes the nearest home to the mother is that of a little infant, not more than four or five weeks old. Show the mother that picture and it makes an impression.

As a rule smallpox has been among those who have not been vaccinated. Even those who have been vaccinated years ago escape infection. I remember what one German woman said to me.

She and her oldest son, about forty, were vaccinated in Germany. The other four children, from twenty-five to thirty-five, were born in America and were unvaccinated. When she paid me $40.00 for attending the unvaccinated for smallpox, she said, "It is cheaper to be vaccinated than to have smallpox."

Dr. Hall (Minneapolis): I would like to say a word about vaccine not taking. It has been our experience that physicians in the city keep coming to us with reports: "Our vaccine does not take;" "We vaccinated, revaccinated and revaccinated." Stories came into my office last fall of cases that were vaccinated six or seven times without success. Our experience has been that in primary vaccinations 98 per cent will work. We have no better virus than that furnished physicians in the city, but we keep it cold. All we get comes direct from the laboratory and is immediately put into the refrigerator and kept there until used. Our experience is that we do not have secondary smallpox cases if we can vaccinate within three days after the first exposure to the primary case. I think there is no question in the minds of any as to the protective influence of vaccination. We have continuously employed at the quarantine hospital in this city any number of helpers, domestics and those helping about the buildings, who never have had the disease and who were simply protected by vaccination, and we have yet to see the first case of smallpox develop in any of these. Out of 361 cases we had during the past year but one occurred in a person recently vaccinated; five others were vaccinated in China and showed but very faint scars. We do not take the patient's word for it. We make him show the scar, and then, if we find none, he says, "I guess it did not take." It seems to me that with the abundant proof of the protective influence of vaccination; with the story in this state of the financial hardship that has been imposed on various communities where the disease has occurred, there can be but one result come from this conference, and that is, to have recommended to the legislature the passage of some law requiring at least compulsory vaccination among school children. If this were accomplished through this conference, our meeting would not have been in vain.

Dr. Jones (Frazee): I have a word to say with reference to the difficulty of carrying out measures for stamping out this disease. We have in our community those who get a little information about some one who died from vaccination, and this they can never forget. It is impossible to impress upon them the fact that most of these reports are false. They will still repeat these stories and

do much harm in a neighborhood. There are others who think their physician knows whereof he speaks, and they submit. But by and by you will meet with a few families who refuse to be vaccinated. Here is where you have the trouble in suppressing a smallpox epidemic.

I have recently disinfected a house where one person who refused to be vaccinated had smallpox four weeks ago. I have disinfected the house and will soon release the inmates provided there are no new cases. I have thought means might be taken to supply these people with information about this accidental infection following vaccination, so that they would have an argument against the stories they hear.

Then again, as regards compulsory vaccination. Probably if we had definite opinions rendered by the state attorney and by the superintendent of public instruction on these measures as to the authority that school boards have in enforcing these measures, it might be of great advantage to communities. We had an illustration of that. Dr. Bracken visited us, and the school board, along with others, took Dr. Bracken's advice in passing a resolution compelling all children attending school to be vaccinated. But this work was just nicely in progress when the superintendent of the school wrote to the state superintendent for instruction as to whether these measures could be enforced. A reply came that was partly in support and partly an evasion, and I observed that the enforcement of the vaccination was not being attended to. The children were going to school unvaccinated. I wrote to Dr. Bracken, and he gave us some advice that was in the line of something definite and positive. I saw the school board again and advised that it take positive measures in this matter. Still they hesitated. I said: "You go ahead and follow the instructions that you get from us as a board of health; if you get into trouble we will be back of you, and if we get into trouble we will go back to the State Board of Health." The school board called a meeting and passed a resolution to the effect that after next Monday no child should be admitted to school unless vaccinated. There were some families who declared they would sue the board if they attempted to keep the children out of school. If an opinion to persons who are writing to the state officials for advice, and likely to come to school boards and health officers, could be definite and sent quick, it might be of great help at times.

Dr. Meighen (Ulen): I firmly believe that the question is up to two things: We are either going to have smallpox until the mate-

rial is burned out, or else we are going to have, through the legislature, compulsory vaccination. I will not stop to discuss the advantages of vaccination. They are all too well known. I will say that I have had seven houses quarantined with from two to ten cases of smallpox in a house, and in those seven houses there are from one to three children successfully vaccinated. The quarantine is from thirty to forty days, and not one case of smallpox has occurred among those vaccinated, although they have slept with the smallpox cases. It is either vaccination or smallpox, and I believe this: that quarantine is not effective. We cannot keep quarantine. I know a case where they ran school with many cases of smallpox present. The teacher had them lying around on the benches. Finally she went home and had the smallpox herself. Our cities and villages are infected from the country. I see from three to five cases every week broken out with smallpox in our village. You advise the township officials to quarantine, and they are afraid to do so without appointing a physician to examine the cases. Then there is a kick because of putting this expense upon the township. We are either going to have vaccination or smallpox. The best way to secure compulsory vaccination is through legislation. Then let the State Board of Health see that the law is enforced. The law cuts no figure if we do not mind it. The sooner we get all vaccinated the better.

Dr. Cool (Faribault): I think our experience is very much the same. I cannot add anything to what has been said except in regard to quarantine. Take it in our city: Our people will stand quarantine better than will those in a little country village, because they have been educated to the point of understanding its necessity. I made up my mind that there was only one way to enforce quarantine, and that was to place a policeman over those quarantined, night and day, with gun and instructions to shoot if they violated quarantine. It is not necessary to use such harsh measures with every one. There are families in all places that will obey, but there is an element in all towns, villages and small cities that will not be quarantined unless you threaten them.

With regard to vaccination being protective in its character: We have in Faribault two illustrative families. In these there were some children who were too young to go to school and others older who were not in school. Those who went to school were vaccinated. Last spring we had quite an epidemic. We had perhaps 150 to 200 cases of smallpox. The older members of these families and those who were too young to go to school and escaped vaccination had

smallpox. There was another family that Dr. Bracken is familiar with, where the mother had smallpox; she never was vaccinated. She had three daughters that were in school the year before, when the vaccination order was promulgated. They were vaccinated and it worked nicely. They took care of their mother—nursed her all the way through her troubles—and neither one of them had any sign of smallpox. There are thousands of just such illustrations.

Now, some one made a remark that a death in a neighborhood was a good thing. There was a family that had the disease and was not quarantined, and particular friends of theirs got the disease from this family and never reported the fact. There were two or three other cases in their midst that were not reported. Finally there was a case of smallpox of malignant type—regular hemorrhagic smallpox—and this one died. That death did me lots of good. A great many school children outside of the city limits and in the country districts that would not have been vaccinated had it not been for that death, are now vaccinated.

In regard to the diagnosis of smallpox: Some of the cases do not have the red spot at all and you do not always find the shot-like feeling. Those guides and landmarks, so far as my experience goes, are frequently wanting.

Dr. Hutchinson: If there is nothing special, we will call on Dr. Bracken now to close the discussion.

Dr. Bracken: I will be as brief as possible in closing. It has been suggested that we should have some literature to counteract the effect of the anti-vaccinationists. I doubt whether we could counteract the anti-vaccinationists in that way. In speaking of these people the other day, Dr. Ohage likened them to the little boy with a tin horn, and that describes the condition exactly. The rest of us have not time to go around blowing tin horns; let the little boys blow. If we are to put out literature to counteract the literature of these ignoramuses, it would have to be yellow journalism literature. I do not believe that many of us have time to write literature for yellow journals.

The point has been raised that we cannot maintain quarantine in country districts. I appreciate the difficulty, but it can be maintained if the first cases are quarantined. Of course, when a community becomes thoroughly infected it is then hard to enforce quarantine. Only two days ago I had word from a health officer that he had not the support of the people and was going to resign. I telegraphed to the village president that unless the health officer had the support of the council, the village would stand a fair chance of

being quarantined against at once. He telegraphed back that the council would give the health officer all the support he needed, and I had a letter within twenty-four hours, saying he had the support. You can control smallpox if you try to.

Is mild smallpox protective? We do not know. We will find out in the course of thirty years. It is certainly a fact that people may have smallpox more than once. I suppose a weak vaccination wears out sooner than a good vaccination.

Quality of vaccine: Dr. Hall explained that nicely. We all know that vaccine is destroyed by warm temperature and we know that the people who prepare vaccine warn everybody that the vaccine must be kept at a low temperature. We know that in Germany there is very little routine vaccination done during the summer months. The vaccine may be all right when it leaves the hands of the producers. It may be overheated in express cars in winter or summer. Supposing the temperature is all right in the express cars. The druggist who receives it may keep it in a room which is too warm. The vaccine is destroyed. The physician who uses this blames the manufacturer unjustly for its poor quality. Dr. Hall says he receives vaccine direct from the producers and keeps it at a low temperature, and that it is then reliable. There is a physician whom I cautioned some time ago to use no vaccine that had not been kept in an ice-box. This physician asked his druggist if he was keeping the vaccine in the ice-box, and he said he was not. The druggist did not take kindly to the suggestion that he should do so. The physician changed druggists. Good thing to do. He has no trouble in getting good vaccination results now. He knows that his vaccine is kept on ice, and that is where it should be kept.

State attorney's opinion: I am glad this was brought up. The sanitarians should, above all things, have the support of schools in sanitary matters, and we have been demoralized by the present and just past superintendents of public instruction. In '99 we issued an order for general vaccination of school children. It was all right until somebody wrote to the superintendent of public instruction. He did not consult with us as to our position. He asked for the opinion of the attorney general. That was all right and legal. The opinion given was that there could be no compulsory vaccination unless an epidemic existed. Following this ruling we advise, when smallpox appears in a place, enforced vaccination. Enforced vaccination has been resisted and there have been five cases tried in the district courts of this state, and in every case the school board was sustained. Last summer I submitted to the attorney general a state-

ment of the number of cases, past and present, in the state, and asked if the disease could not be recognized as epidemic in the state and if the state had not the right to order general vaccination of all school children in the state. An opinion came from the attorney general's office to the effect that smallpox could be recognized as epidemic, and that the State Board of Health had a right to give such an order. A special meeting of the board was called to bring about such action, and it issued an order. Some school superintendent wrote to the superintendent of public instruction at St. Paul and asked for his opinion. He did not go to the trouble of inquiring into present conditions. He had the opinion of the attorney general given in '99 to the effect that vaccination could not be enforced unless an epidemic existed in a place. He advised that our regulation was not legal. A law suit is liable to result in one school district, due to this kind of advice from this superintendent of public instruction, who should be working with us instead of against us. In this last case I asked him if he was an anti-vaccinationist, drawing his attention to the fact that his course of action had already been quite an expense to the state.

Another thing about sore-arm vaccinations. You naturally can understand that if there is no general vaccination except when a scare comes, and with it hurried vaccination, it is natural to have sore arms. People should be vaccinated when there is least danger of infection, viz, in infancy. Every child ought to be vaccinated before six months old. There would not be any tetanus if children were vaccinated and taken care of when in the cradle.

Reference was made to an infant born and showing evidence of smallpox. There have been a number of such cases reported; and there have been numbers of cases where the child developed smallpox a few days after its birth, showing that it received its infection *in utero*. I want to say that the large percentage of deaths have been among pregnant women and newly born children. If people would appreciate the risk women are running with this disease epidemic they might be a little more careful than they are.

A suggestion was made that there should be legislation, and then power given to the state board to enforce same. I think we have plenty of law. The only point is that the State Board of Health officials cannot be everywhere. The local boards have just as much power as the state board. They have almost absolute power when dealing with contagious diseases. I know a good many hesitate in action, but they have the power to act if they wish to. If one place does not handle contagious diseases properly neighbors can quarantine against it.

Dr. Meighen: I would like to ask the secretary of the State Board of Health if the State Board of Health has funds to carry on the work absolutely. You cannot do it unless you go out and see it done.

Dr. Bracken: I can say we have not funds to do anything like that.

Dr. Hall: I move that action be taken, if possible, at the coming session of the legislature, to secure a compulsory school vaccination law; not a vaccination law that would apply as the attorney general's opinion states—only in case of epidemic. Take our experience in this city. We vaccinated last fall 1,300 pupils, and then the school board decided, through their legal advisers, that only in certain cases can vaccination be enforced. Give us a law that will enforce compulsory school vaccination at any and all times. We have no trouble where there is an epidemic. I believe that Dr. Bracken can handle that part of it. We have been able to vaccinate everybody we have tried to. If they do not wish to be vaccinated we take them to the police court. If they still refuse we have them arrested again. They finally submit to vaccination. The thing is to get at the school population.

The motion was seconded and carried.

Dr. Bracken: It is about time for us to adjourn, and I suppose it is in line for the State Board of Health to thank those who have attended this meeting and to express its appreciation for the support that has been given it. I can assure you that there has been some worry and uncertainty as to what the outcome of this meeting would be. I am very well satisfied with this as the first meeting, a meeting for organization, and I hope that the outgrowth will be a strong sanitary association that may number amongst its members not only medical men, but those from the laity interested in sanitation; also those representing various professions—engineers, chemists, etc.; and ladies who are interested in the work.

Meeting adjourned.

AFTERNOON SESSION, WEDNESDAY.

The meeting was called to order by Dr. Hutchinson in the rooms of the Hennepin County Medical Society, and the Committee on Organization made the following recommendations:

(1) That a permanent organization be formed, the name of which shall be the Minnesota State Sanitary Association, with the

following officers: A President, three Vice-Presidents, and a Recording Secretary-Treasurer.

(2) That the following standing committees be created:

(a) Programme Committee.

(b) Committee on Municipal and Sanitary Engineering.

(c) Committee on Tuberculosis.

(d) Committee on Infectious Diseases of Men.

(e) Committee on Infectious Diseases of Animals.

(f) Committee on School Hygiene (to include public baths, etc.).

(g) Committee on Woman's Work in Sanitation.

(h) Committee on Disinfectants.

(i) Committee on Vital Statistics.

(k) Committee on Vaccination.

(l) Committee on Legislation.

(3) That the chairmen of all committees report to the Programme Committee, upon which rests the responsibility for the arrangement of papers, etc., for each meeting of the Association. The President of the Association shall be ex-officio a member of the Programme Committee.

(4) That each committee shall consist of three members with the exception of the Programme Committee, which shall consist of seven members.

(5) That the President elect shall appoint the committees.

(6) That the present committee of organization shall report at the next annual meeting, at which time it shall recommend a constitution and by-laws for the Association.

(7) That the membership fee shall be fixed at $1.00, and that the Association shall be open to all citizens interested in sanitary questions. The object of the Association, sanitary progress.

Each item of the report was introduced by vote, and the report of the committee as a whole thereupon accepted.

The nomination of officers presented by the Committee on Organization was taken up with the following results:

For the ensuing year:

President....................................Dr. H. M. Bracken
First Vice-President................Dr. J. M. Robinson, Duluth
Second Vice-President..............Dr. E. A. Spalding, Luverne
Third Vice-President............Prof. J. J. Flather, Minneapolis
Recording Secretary-Treasurer.......Dr. E. H. Bayley, Lake City

The time and place of next meeting was left to the Committee on Programme to determine. A vote was taken in favor of holding meetings in the Twin Cities, as being most convenient for all

parties at all times. A suggestion was made that the meeting should be held between Thanksgiving and Christmas.

The President for the ensuing year was instructed to formulate a resolution as coming from the Association, urging local authorities to send health officers to this Association, paying their expenses while in attendance.

The Committee on Organization, by vote, determined that a subcommittee of four should be appointed, including the chairman of the committee, Dr. Hutchinson, to draw up constitution and by-laws to present to the next annual meeting.

Dr. Hall (Minneapolis) gave an informal talk on the Disposal of Garbage, dealing largely with the methods at present carried out in Minneapolis. The paper was discussed by Mr. Sublette, city engineer of Minneapolis, and others.

Adjourned.

REPORT OF THE

SECRETARY AND EXECUTIVE OFFICER.

1901-1902.

INTRODUCTION.

In presenting an introduction to another biennial report of the Minnesota State Board of Health, it may be well to say a few words in relation to preventive medicine. It is not the medical education of medical men that will bring about the greatest improvement along these lines. Rather it is the use of well recognized sanitary requirements of which we now have knowledge.

Too often it is the case that the physician who is acting as health officer in a village or city is handicapped in the performance of his duties by the ignorant opposition of the laity and the commercial opposition of certain of his brother practitioners. The former should be overcome by a united effort of the medical profession to educate the people as to the actual needs in connection with isolation, disinfection and quarantine. This can best be accomplished through local sanitary organization which should be made up of the prominent people of the village or city.

If the people understand the cause of the various communicable diseases, the manner in which these causes are transmitted from one person to another, and the means to be used to prevent such transmission, the duties of the medical profession will be made easy and there will be no occasion for the continued opposition to the health officer by those unprincipled physicians who try to make professional capital by siding with the quarantined individuals in their opposition to sanitary requirements.

If the sanitary education of the laity in villages and cities is carried out, it will greatly aid in the elimination of preventable diseases from such places. It will then become necessary to extend this educational work to the country districts. Here a somewhat different plan will have to be carried out so far as the laity is concerned, for the population is too scattered. Still further, the sanitary demands are more easily fulfilled, for with a scattered population the danger of spreading infectious diseases is much less than that existing in villages and cities. For example: If diphtheria should appear in a family in the country the disease should be easily limited to the one family, *provided* the disease is recognized early, for there need be no direct communication between those who are hosts of the diphtheria bacillus and the people who are germ free in the surrounding country. Such isolation of *all hosts* of the diphtheria bacillus in a village or city is sometimes secured only with great watchfulness.

Sanitation in the country districts can be made efficient through a thorough education of the township officials of matters pertaining to infectious diseases, and the close association of such officials with intelligent county and state sanitary officials. As yet the county sanitary official can hardly be said to have an existence in this state. A bill was passed by the legislature of 1901 providing for a county health officer, but this made little provision for him to exercise intelligent authority. There is practically nothing in the way of a sanitary advisor between the State Board of Health and the township officials. It too often happens, therefore, that when sanitary problems present themselves in country districts no effort is made to deal with them until the conditions demanding attention become widespread and alarming.

Every county should have an intelligent medical health officer. Such officers should be men of ability, with a good standing in their profession; they should be men who command the respect of the community in which they live. They should receive reasonable compensation for their services. They should be worthy of their hire, looking at the matter both from the sanitary and the commercial point of view, for through their efforts lives are saved, and at the same time expense should be reduced to a minimum, both for individuals and the county. As a money investment, a county health officer, provided he is a man of intelligence and at the same time conscientious and thoroughly honest in his dealings, should be an important element in every county in this state.

With such organizations as now exist and should exist, as thus outlined, the sanitary machinery should be put in perfect condition. In the country the township and the county health officers should work together; in villages and cities the sanitary organizations and the health officer should work together. Still further, all of these organizations should join hands with the State Board of Health in order to secure the best results for the entire state.

To bring about this latter proposition, nothing can be of more value than the Minnesota State Sanitary Association, that was organized January, 1902. This organization should have among its members every health officer throughout the state, as also a strong representation from the laity and the various professions.

This sanitary conference passed a resolution requesting the president for this year to urge local authorities to send their health officers to this association, paying their expenses while in attendance.

To place the sanitary machinery outlined above in thorough working order it will be necessary to secure a revision of our present sanitary laws.

What is secured through preventive medicine? The removal of disease causes; diminished suffering; fewer premature deaths.

Who should have the greatest interests in such matters? The public. As a matter of fact, however, the general public is apparently lukewarm while the medical profession is at work. Strange, indeed, is this. A profession working apparently to remove the causes for its existence, while those who are receiving the benefit look on with indifference.

It is true tuberculosis has become such a scourge that organizations looking to its suppression have started up, and these reach the public in ways that are practical and beneficial, but this is but a drop in the bucket. Consumption kills its thousands, but the polluted drinking water, the lack of sanitation at home and in public places, the selfishness that leads us to consider our own temporary inconvenience rather than the good of our neighbor, these all have a place in causing unnecessary suffering and death.

King Edward, in discussing tuberculosis at a recent congress in London, said: "If preventable, why not prevented?" The same can be asked with equal pertinence of a list of diseases that is constantly growing larger as we learn more of their cause. The public is best reached through systematic organizations, and these, when of the best type, consist of many parts working as a unit.

Preventive medicine can be studied to advantage through civic leagues, improvement societies, various women's organizations, etc. Women's organizations should have a prominent place in this work, for there is no one who suffers to a greater extent because of preventable diseases than the mother. Sickness means nursing, worry, exhaustion, and money loss, and sickness in a family throws all this upon the mother. Why should she not be indignant when a preventable disease appears in her household?

Second only to the organizations just referred to are the public schools. Teachers should have at least fair sanitary training and should make good use of their knowledge. One has but to note the increase in diphtheria, scarlet fever, etc., upon the opening of schools in the fall to realize the power that teachers can and should use in the prevention of disease. A child with a suspicious sore throat may attend school. A teacher may assume that it is no part of her duties to note such fact. Her indifference may be followed by many cases of diphtheria; much suffering and death; de-

moralization of the schools; and even financial demoralization throughout the community. On the other hand, a hint from the teacher that a child had a sore throat should lead to a prompt medical examination of the suspected individual, its exclusion from school, and the removal of all further danger from infection. Many teachers realize their responsibility in connection with sanitary matters and are of great assistance to health officers. Teachers should be instructed in matters pertaining to sanitation at their various gatherings (summer schools, etc.), or during preparation for their life work (normal schools, high schools, universities, etc.) Not enough attention is given to these matters in this state at the present time.

The work of the board has progressed favorably during the past two years. The office capacity has been greatly increased and improved at but little expense by simply converting two rooms that had formerly been used as store rooms into an office for the secretary and a filing room. By this arrangement it was possible to set aside one room for the director of the Veterinary Department and one room for the stenographers. The demands upon the secretary and upon the entire clerical force have been constantly increasing.

The smallpox epidemic has required much attention and to a certain extent has interfered with the introduction of new sanitary problems.

It is scarcely necessary in this introduction to speak of the laboratory, for the report of its director shows fully the work that is being done along the lines of investigation, both for infectious diseases of men and of animals. Suffice it then to say that under the directorship of Dr. Wesbrook the laboratory has come to be a most important part of the State Board of Health. The work done upon diphtheria alone has been of sufficient importance to justify the maintenance of the laboratory, for not only has this been of inestimable value to physicians throughout the state, but it has also received the recognition of scientific men far and wide. But the work of the laboratory has by no means been confined to routine and research as pertaining to this disease, for the report of its director shows plainly that many other diseases of mankind have received due consideration.

Not least in importance as pertaining to the laboratory work is its bearing upon the infectious diseases of animals as shown by the reports upon rabies, haemorrhagic septicaemia, glanders, hog cholera, etc.

The animal house now under construction will greatly facilitate the laboratory in its study of communicable diseases.

The work of the Veterinary Department has been most satisfactory under the able direction of Dr. S. D. Brimhall. The advantages gained by the study of infectious diseases of men and animals under one and the same department are continually emphasized in the present methods of our board. The laboratory work as carried on for both divisions under one and the same directorship is of great economical advantage to the state. So, too, is the opportunity for consultations between the director of the Veterinary Department, the secretary of the board and the director of the laboratory. In addition to the economical gain to the state through such consultations is the advantage of joint study of diseases that are transmissable from animals to man as shown in the study of bovine tuberculosis, rabies, glanders, trichinosis, etc. I think it can safely be said that in no state in the union has there been better work along the lines of infectious diseases of men or animals during the past few years than in Minnesota.

The chemical work of the board has been excellent so far as it has been possible to carry it out. Unfortunately the lack of funds has interfered materially with this part of our duties to the state.

HISTORY OF THE BOARD.

In 1872 a bill was presented to the State Legislature looking to the establishment of a State Board of Health. The bill was passed and approved March 4, 1872. It provided for a board consisting of seven physicians, each member to hold office for a term of four years. Governor Horace Austin thereupon appointed Drs. D. W. Hand of St. Paul, A. B. Stuart of Winona, N. B. Hill of Minneapolis, A. W. Daniels of St. Peter, and C. N. Hewitt of Red Wing, and instructed Dr. Hand to call the first meeting. This meeting was held in St. Paul, March 26, 1872. Dr. A. B. Stuart was chosen president and Dr. C. N. Hewitt permanent secretary. Later in the year Drs. Vespasian Smith of Duluth, and G. D. Winch of Blue Earth, were added to the board. The membership of the board from its beginning to the present time is shown by the accompanying table.

Dr. Stuart, the first president, held his membership but one year, withdrawing at that time on account of ill health. Dr. Hand succeeded Dr. Stuart as president and continued to hold this office until the time of his death, June 1, 1889, a period covering seventeen and a half years. Dr. Franklin Staples of Winona, who had

been appointed to the board to succeed Dr. Stuart, was elected president following Dr. Hand's death, and he has served in that capacity up to the present date, covering a period of thirteen years. Dr. C. N. Hewitt, one of the original members of the board, served as its secretary from March 26, 1872, to the date of his retirement from the board January, 1897, almost twenty-five years.

The sanitary laws were revised in 1883.

In 1894 the membership of the board was increased to nine.

From the time of organization to May, 1894, the office of the board was at Red Wing. It was then moved to St. Paul and located in the Pioneer Press building, there being no vacant space in the Capitol building. The same year rooms were assigned to Dr. Hewitt in the upper floor of the Mechanics Arts building (University of Minnesota), and here he conducted the chemical and bacteriological examinations for the board.

In 1896 Dr. F. F. Wesbrook, of Minneapolis, was made a member of the board, and April of the same year he was elected to serve as bacteriologist. At this time the bacteriological work of the board was transferred from Dr. Hewitt's laboratory to rooms assigned for this special work in the laboratory building of the Medical Department of the University. The chemical work of the board was continued under Dr. Hewitt's direction.

In 1885 the first law relative to the infectious diseases of animals was passed and this work was placed under the control of the State Board of Health.

In 1897, Dr. M. H. Reynolds, veterinarian at the Experiment Station and teacher at the School of Agriculture, University of Minnesota, was made a member of the board, taking Dr. Hewitt's place, his term having expired. Dr. Reynolds was first made chairman of the committee on infectious diseases of animals, but soon after his appointment the board created a distinct veterinary division, of which he was made director. This position he held until August 1, 1900, conducting the duties of this department from his office at the Experiment Station. In 1900 it was thought desirable to concentrate the executive work of the board so far as possible, and the veterinary division's headquarters were transfered from the Experiment Station to the general offices of the board in the Pioneer Press building. Dr. S. D. Brimhall, who had been serving as field veterinarian under Dr. Reynolds from February, 1897 (appointment for regular work began August 1, 1897), was placed in charge of the veterinary work that had previously been carried

on by Dr. Reynolds. At the meeting of the board July 9, 1901, Dr. Brimhall was given the title that had formerly been held by Dr. Reynolds, viz., Director of the Veterinary Department.

With the growth of the state the work of this board has constantly been increasing. In 1894 when the office was removed from Red Wing to St. Paul there were the secretary, four clerks and a chemist; at the present time (1902) there are eighteen individuals in the employ of the board.

The work of the board consists of

(1) Executive duties, under the secretary.
(2) Vital Statistics, under the secretary.
(3) Clerical duties, under the secretary.
(4) Laboratory work, under a director.
  (a) Bacteriological, routine and research.
  (b) Chemical, routine and research.
(5) Veterinary work, under a director.
  (a) Executive and in field.
  (b) Laboratory, routine and research.

BIOGRAPHICAL SKETCHES OF THE FIRST MEMBERS AND OF DECEASED MEMBERS OF THE BOARD.

DR. A. B. STUART was born at Williamsburgh, Pa., August 27, 1830, and died at Santa Rosa, California, July 30, 1897.

His academic training was received at Lewisburgh University in Pennsylvania; his medical training at Berkshire Medical College, Pittsfield, Mass., graduating from this latter institution November, 1856. He studied at Bellevue Medical College and received an ad eundem degree in 1866. Prior to graduation in 1856 he held the position of demonstrator of anatomy in the school where he was a student. He first began practice at West Hampton, Mass. In 1858 he removed to Macomb, Ill. August, 1861, he entered the army as assistant surgeon 10th Missouri Infantry Volunteers. In the fall of the same year, while aiding in the construction of a fort, he was crushed between two logs and partially paralyzed. From this injury he never completely recovered. He was promoted April 1, 1863, and became surgeon 1st regiment Alabama Volunteer Cavalry (white). He continued in service until January, 1864, when he resigned because of ill health. His home was at Winona, Minn., from June, 1866, to July, 1876. During this time he had been compelled to seek a change of climate from time to time on account of ill

health. In 1876 he settled at Santa Barbara, Cal., and in 1880 he removed to Santa Rosa, Cal., where he continued to practice until the time of his death.

He assisted in the organization of the Winona County Medical Society and was its president in 1872. He was a delegate from the Minnesota State Medical Society to the International Medical Congress at Philadelphia in 1876. He was largely instrumental in securing the establishment of the Minnesota State Board of Health, and was its first president. He was a member of the Minnesota State Medical Society from its organization. He was also a member of the American Medical Association, of the Massachusetts Medical Society and of the California Medical Society.

DR. ASA WILDER DANIELS was born at Stratford, N. H., January, 1829. He received his preparatory education at the Lancaster Academy. He entered the office of his uncle, Dr. B. F. Hatch, in Boston, in 1849, where his medical education was commenced and continued for four years.

He graduated from the Boston Eclectic Medical College in 1853. In 1865 he took a post graduate course at the Bellevue Medical College, New York city, and graduated from the Medical College of Ohio, Cincinnati, March, 1866.

He came to Minnesota July, 1853, and his first eight years were passed in the government service as post surgeon at Fort Ridgley, and as resident medical officer at the Lower Sioux Agency. At the latter place his charge consisted of the government employes, missionaries, traders, and twenty-five hundred Indians.

He resigned from this position July, 1861, and removed to St. Peter, where, for more than forty years, he has devoted himself assiduously to the duties of his profession and the good of his fellow citizens.

Dr. Philander P. Humphrey was appointed to succeed him at the agency, and in the Indian massacre the following year (1862) was killed, with his wife and two children.

The doctor participated in the defense of New Ulm, and after the battles that followed most of the wounded under his charge were taken to St. Peter, where, with the assistance of his brother, Dr. J. W. Daniels, a hospital was established for their reception. In charge of the hospital he remained in the state's service until January, 1863.

He was one year (1872) a member of the State Board of Health, resigning from that position on account of ill health and urgent

professional duties. He was for fifteen years single pension examiner, and four years a member of the pension examining board at Mankato. He was also nearly three years a member of the board of trustees of the state hospital for the insane.

On his return from a winter in California, in May, 1902, the citizens of St. Peter did him the honor of presenting him with an address and a beautifully engraved silver loving cup, in commemoration of his long and beneficent service as citizen and physician. It was a most fitting symbol of the love and affection the people have for the man who for nearly fifty years had worked for the public good, ministering to the wants of the people and devoting his life to caring for the ailments of the human family. The tribute and honor thus paid to him by his fellow citizens was a crowning event in a most honorable career. It was valuable, not because of the gift, but for what it symbolized and carried with it—the love of a whole community for a great and good man.

* DR. NATHAN B. HILL was born in Randolph county, North Carolina, May 13, 1817, and died at St. Paul, Minn., Feb. 6, 1875. He received his early education at Ashboro, N. C., and at a "Friend's" boarding school at New Garden, N. C. He finished his academic studies at the Haverford College near Philadelphia. He attended lectures at the Jefferson Medical College, Philadelphia, in 1842.

In 1845 he married Eliza Mendenhall and moved West.

During the season of 1847-48 he attended lectures at the Ohio Medical College, receiving his degree from that school. He then returned to his former home in North Carolina, where he practiced medicine until 1861, when he was forced to flee from the South on account of his anti-slavery sympathies, and settled in Minneapolis. He was appointed one of the first members of the Minnesota State Board of Health by Governor Austin in 1872, and served as such up to the time of his death. While presiding as president of the State Medical Society, at a meeting in St. Paul, he was taken ill and died three days later at the home of Dr. J. H. Murphy.

He was a favorite among his professional associates, His life was unostentatious, but marked by the conscientious and faithful discharge of every duty to which he was called.

DR. DANIEL W. HAND, born Aug. 8, 1834, at Cape May, C. H.; New Jersey; died at St. Paul, July 1, 1889.

He received his academic training at Lenmont Academy, Norristown, Pa., and at the University of Lewisburgh. Graduated in medi-

*From the proceedings of the State Medical Society.

cine from the University of Pennsylvania in 1856. Commenced practice in St. Paul in 1857 as a partner of Dr. Willey.

He entered the army as assistant surgeon early in 1861, and was quickly promoted to the rank of surgeon, U. S. Volunteers. He was medical director in the department of Virginia in 1863, and of that of North Carolina in 1864-65. His work as a sanitarian in dealing with yellow fever in the army was conspicuously satisfactory. He was breveted lieutenant colonel of U. S. Volunteers.

He was wounded at Fair Oaks in 1862; was captured in a skirmish and sent to Libby prison in 1863. He was honorably discharged from the army, December, 1865.

He was named as one of the first members of the Minnesota State Board of Health, and instructed by Governor Austin to call the first meeting of the board, which he did on March 26, 1872. He became president of the board in 1873, succeeding Dr. A. B. Stuart, and continued to serve as such until the time of his death, covering a period of sixteen and one-half years.

He was recognized as one of the leading general practitioners in the state, and as a prominent citizen of St. Paul. In 1868 he was married to Susan M. Freeman of Petersburgh, Va.

DR. VESPASIAN SMITH was born in Mt. Vernon, Ohio, Oct. 21, 1818. His parents were Virginians, who had moved to that locality in the spring of 1805. He attended the common schools of Mt. Vernon and afterwards prepared himself for teaching, following that vocation for one year, when he took up the study of medicine, under the tutelage of Dr. J. N. Burr. Subsequently he entered the medical department of the Western Reserve College of Cleveland, graduating from that institution with the class of 1851. He practiced for several years in New Carlisle and Columbus, Ohio, from which later place he removed to Superior, Wis., in 1857, when that section was little more than a wilderness. He remained in Superior until 1860, when he received a government appointment as physician to the Indians at the Bayfield agency. This position he held for eight years—and they were hard years, too. It is known that at times he traveled forty miles in an open boat on Lake Superior to visit a sick Indian, and he never refused a call, no matter how hard it was or what the circumstances. Subsequently he was made register of the land office at Bayfield, which position he held for two terms.

With the first year of the building of the St. Paul and Mississippi River railroad, afterwards the St. Paul & Duluth R. R., Dr. Smith located in Duluth, and from that time until his death he was always

a prominent figure. He was appointed the second collector of customs of the port of Duluth and held the office for nine years, under three administrations. Dr. Smith probably received more government appointments, under more different administrations, than any other man in the northwest, his first coming under Buchanan's administration, and others following under every administration, up to that of President Cleveland.

He was for two years mayor of the city of Duluth, and his popularity is evidenced by the fact that at his first election there was not one vote against him, and at the second there were but three, and one of these adverse votes was cast by himself. He was elected first president of the St. Louis County Medical Society, and about the same time was appointed a member of the State Board of Health, a position he held for twenty years.

Dr. Smith was married in 1846 to Charlotte E. Neely, of New Carlisle, Ohio. He died in Duluth, Minn., October 11, 1897.

DR. GEORGE WINCH. But little can be written of this man. A short sketch of his life in Minnesota is given in the North Western Lancet of August 1, 1902 (page 292).

He was one of the first members of this board, but after serving one term (four years) it is stated that he declined a reappointment. The sketch referred to above states that he was a graduate from Rush Medical College; that he was a surgeon in a Wisconsin regiment during the war; that he moved from Wisconsin to Blue Earth, Minn., about 1867.

The date of his death is not given, but his age at time of death is said to have been about thirty-eight. He is described as a much respected and very busy general practitioner, his practice extending into Northern Iowa.

He was not married.

*DR. CHARLES NATHANIEL HEWITT. Born at Vergennes, Vermont, June 3, 1836. His literary education was obtained at the Chershire Academy, Connecticut, and Hobart College, New York.

His medical degree was from the Albany Medical College, 1857. He was valedictorian of his class. The same year he received his M. A. degree.

During the year previous to graduation in medicine he was demonstrator of anatomy at the Geneva Medical College. He began the practice of medicine at Geneva, N. Y., in 1857, and this was his residence until 1861, when he entered the army with the rank

*From "Physicians and Surgeons of the United States."

of assistant surgeon, 50th New York Volunteer Engineers. For one year he acted as surgeon of that body. He was afterwards surgeon in chief of the engineering brigade, Army of the Potomac, for two years.

Soon after the close of the war he settled at Red Wing, Minn., and this has been his home ever since. He was one of the first members of the Minnesota State Board of Health, receiving his appointment through Gov. Austin. At the first meeting of the board, March 26, 1872, he was chosen its permanent secretary, and in this capacity he continued to serve until January, 1897, his entire period of membership.

In 1874 he was chosen professor of public health in the University of Minnesota, and this position he continues to hold.

In 1866 he married Helen Hawley, daughter of Dr. J. E. Hawley of Ithaca, N. Y., who was professor of surgery in the Geneva Medical College.

Dr. Hewitt is a member of the Minnesota State Medical Society, the American Public Health Association, and the American Medical Association. He has served as president of the first two. He is also an associate member of the Society of Hygiene, France.

*DR. ALBERT EDWARD SENKLER. Born March 8, 1842, at Docking, Norfolk, England; died at St. Paul, Minn., Dec. 10, 1899. His father was a clergyman in the Church of England and removed to Brockville, Ont., when the subject of this sketch was a mere boy.

Dr. Senkler received his literary training under the tutorship of his father; his degree of M. D., C. M. from the University of McGill in 1863. Two years after graduation he began practice at St. Cloud, Minn. In 1880 he removed to St. Paul, and here he continued to the time of his death. He was appointed a member of the Minnesota State Board of Health in 1873, upon the withdrawal of Dr. A. W. Daniels, and served through 1875. He was connected with the medical department of the University of Minnesota as a professor in clinical medicine.

He is described as a "gentleman of the noblest type;" a scholar in medicine; an accomplished physician, beloved by patients and fellow practitioners.

His remains are buried at Brockville, Ont.

DR. JUST CHRISTIAN GRONVOLD, Norway, Minn., son of Fredrick Martin and Johanna (Borgen) Grónvold, grandson of Just

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*From the St. Paul Medical Journal, 1900.

Christian Grónvold, was born February 27, 1833, at Front Gudbrandsdalen, Norway. He was educated in the Cathedral school, Christiania, Norway, from which he was admitted to the University of Norway, Christiania, where he took *examen artium*, 1851, with Laudabilis; *examen philosophicum*, 1852; and in 1857-59 *examen realium* in mathematics and natural philosophy. From 1858 to 1861 he was teacher in mathematical branches in the Sylows Polytechnic Institute and in other schools in Christiania, Norway. Later he was for some years engaged in surveying. In Norway, it is the duty of every able bodied man to do military service, and he served as second lieutenant in the army. In 1865 he came to America, and settled in St. Louis, Mo. He commenced the study of medicine in 1867, attending two courses at the Humboldt Medical College, St. Louis, from which he was graduated in 1869. He commenced the practice of medicine in Goodhue county, near Norway, Minn. He was a member of the Minnesota State Board of Health, 1876-1887, inclusive, and as such wrote some reports on leprosy in that state.

Dr. Grónvold was a member of the Minnesota State Medical Society, American Medical Association, and the American Public Health Association.

Married, November 3, 1874, Ellen Brandt, of Valders, Norway.

He died September 14, 1895, and was buried in the "Hauges" Synod's Cemetery at Aspelund, Minn.

DR. PERRY H. MILLARD. Born May 14, 1848, at Ogdensburg, N. Y.; died in Johns Hopkins hospital, Baltimore, Md., Feb. 1, 1887. He graduated from the high school at Ogdensburg, N. Y., when seventeen years old. He began the study of medicine at the Michigan University, but completed his medical work at the Rush Medical College, from which he graduated in 1872. He practiced medicine for a time at Stillwater, and then removed to St. Paul, where he was living at the time of his death. He was actively connected with medical legislation, and was largely responsible for the passage of the present medical practice act, which has done much toward elevating the standard of medicine in Minnesota. He was a member of the State Board of Health about nine years, and during this period was most active in urging a high standard for its work. He it was who deserves the chief credit in the founding of the medical department of the University of Minnesota, which became a teaching body in 1888. He was dean of the College of Medicine and Surgery from its organization (1888) until the time of his

death in 1897. He was a member of the Medical College Association, and took an active part in the demands for higher medical education. He was a man of strong personality, unlimited energy, clear judgment, immovable resolution, with a masterly comprehension of future needs. With such characteristics it was but natural that he should overtax his constitution. For some time prior to his death his health had been failing. Finally he was compelled to lay aside his work and seek medical advice, but it was too late, and his failure was gradual but rapid from the time that he gave up until his death.

In 1879 and '80 he spent six months abroad at the hospitals of London and Germany. He was a member of many medical societies. His public services have left an imprint upon the medical profession of Minnesota that time will not efface. A wife and two children survive him.

RECORD SHEET OF THE MEMBERS OF THE MINNESOTA STATE BOARD OF HEALTH, FROM ITS ORGANIZATION (1872) TO 1902.

Name.	Address.	Year.																															Remarks.	Succeeded by—
		1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.		
Stuart, A. B.	Winona	‡																															Resigned.	F. Staples.
Daniels, A. W.	St. Peter	‡																															Resigned.	A. E. Senkler.
Hill, N. B.	Minneapolis	‡	‡	‡	*																												Died Feb. 5, 1875.	W. H. Leonard.
Winch, G. D.	Blue Earth	‡	‡	‡	‡																												Declined reappointment.	E. J. Davis.
Hand, D. W.	St. Paul	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	*														Died June 1, 1889.	P. H. Millard.
Smith, V.	Duluth	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡													C. F. McComb.
Hewitt, C. N.	Red Wing	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡								M. H. Reynolds.
Staples, F.	Winona		‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡		
Senkler, A. E.	St. Cloud		‡	‡	‡																												Left state temporarily.	J. C. Gronvold.
Leonard, W. H.	Minneapolis				*	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡										H. Hutchinson.
Davis, E. J.	Mankato					‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡													W. J. Mayo.
Gronvold, J. C.	Holden					‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡																	J. H. Phillips.
Millard, P. H.	St. Paul																		*	‡	‡	‡	‡	‡	‡	‡	*						Died Feb. 1, 1897.	C. L. Greene.
Phillips, J. H.	Preston																	‡	‡	‡	‡	‡	‡											W. L. Beebe.
Mayo, W. J.	Rochester																					‡	‡	‡	‡	‡	‡	‡	‡					C. H. Mayo.
McComb, C. F.	Duluth																					‡	‡	‡	‡	‡	‡	‡	‡					S. M. Stocker.
Beebe, W. L.	St. Cloud																							‡										H. M. Bracken.
Boekmann, E.	St. Paul																							‡										K. H. E. Nissen.
Hoegh, K.	Minneapolis																							‡	‡									F. F. Wesbrook.
Hutchinson, H.	St. Paul																								‡	‡	‡	‡	‡	‡	‡	‡		
Nissen, K. H. E.	Albert Lea																								‡	‡	‡	‡	‡	‡				W. H. Rowe.
Bracken, H. M.	Minneapolis																								‡	‡	‡	‡	‡	‡	‡	‡		
Wesbrook, F. F.	Minneapolis																									‡	‡	‡	‡					E. Shumpik.
Reynolds, M. H.	St. Anthony Park																										‡	‡	‡	‡	‡	‡		
Greene, C. L.	St. Paul																										*	‡	‡					R. F. Whetstone.
Mayo, C. H.	Rochester																													‡	‡	‡		
Stocker, S. M.	Duluth																													‡	‡	‡		
Whetstone, R. F.	Argyle																													‡	‡	‡		
Shumpik, E.	Minneapolis																													‡	‡	‡		
Rowe, W. H.	St. James																														‡	‡		

‡ Full year. * Part year.

REGULAR QUARTERLY MEETING.

Jan. 15, 1901.

The meeting was called to order at 10:30 a. m.

Present—Drs. M. H. Reynolds, Edward Shumpik, R. F. Whetstone, C. H. Mayo, S. M. Stocker, Henry Hutchinson and H. M. Bracken.

The minutes of the regular meeting of Oct. 9, 1900, were read and approved.

Election of Officers—In the regular manner the following officers were chosen:

President—Dr. Franklin Staples, Winona.

Vice President—Dr. Henry Hutchinson, St. Paul.

Secretary—Dr. H. M. Bracken, Minneapolis.

Executive Committee—

Ex-officio—The officers of the board.

Elective—Dr. C. H. Mayo, Rochester; Dr. M. H. Reynolds, St. Anthony Park.

Attorney—Harris Richardson, St. Paul.

Dr. Bracken suggested that regulations should be prepared for consideration by the board at its next regular meeting relative to the testing of dairy and pure bred cattle. This, by motion, was referred to the executive committee.

Dr. Reynolds stated that Minnesota, sooner or later, would be compelled to take some action forbidding the importation of untested dairy or pure bred cattle. This, by motion, was referred to the executive committee to be reported upon at the next meeting of the board.

Dr. S. M. Stocker was given authority to act as state inspector in St. Louis county in connection with the control of contagious and infectious diseases, this authority carrying with it no expense to the state.

The following resolution was presented by Dr. Bracken and by motion adopted:

Whereas, A large majority of the cases of small-pox that have occurred throughout this and other states during the past year were, at the time dis-discovery, unattended by a physician and unreported by the family (the same being secreted so far as possible), thereby contributing to the spread of the disease and rendering it difficult if not impossible to suppress the same; therefore, be it

Resolved, That the State Board of Health, in the interests of the public, request all local boards of Health to see to it that Sec. 22, Chapter 132, of the Laws of 1883, is enforced.

It further requests that whenever any eruptive disease showing papules, vesicles, pustules, etc., or any condition resembling measles, scarlet fever, chickenpox or smallpox, which shall appear upon any person (member of the family, boarder, roomer or visitor), the head of the family, the keeper of the house or some member thereof, shall, within twenty-four (24) hours after the discovery of such eruption report each and every case to the Local Board of Health, unless said case or cases are attended by a physician, as provided for in sections 22 and 23 of the aforesaid law.

Any person violating any of the provisions of this regulation should be prosecuted as directed by the law relating to the infectious and eruptive diseases, Chapter 132 (1883).

The following resolution was presented by Dr. Bracken, and by motion adopted:

Resolved, That railroads, lumber camps, mining camps or other corporations having many employes be requested to see that a successful vaccination be insisted upon as a condition of continuing such employe in service.

Messrs. Craig & Wilwerscheid, representing the State Embalmers' Association, presented the following resolutions:

Whereas, About two hundred embalmers practicing in the state of Minnesota have passed an examination and been licensed to prepare bodies for shipment upon the railroads in this state, the number of licensed embalmers being nearly one-half of the whole number doing business in this state; and,

Whereas, It is quite necessary that bodies of those dead from infectious and contagious diseases shall be thoroughly disinfected by the process of embalming for local interment, as well as for transportation upon the railroads within the state; therefore, be it

Resolved, That the President be authorized to appoint a committee on legislation, which committee shall be charged with the duty of preparing such further legislation as may be necessary to enable the State Board of Health to have supervision of all embalmers, and extend the present license system as soon as possible to all embalmers assuming to embalm whether for transportation or for local burial.

Whereas, Rules and regulations have been made concerning the manner in which bodies shall be prepared for shipment out of the state; and,

Whereas, Some of the states bordering on Minnesota and a number of the states from which bodies are shipped to Minnesota have no such regulations; therefore be it

Resolved, That the State Board of Health be requested to make rules and regulations which shall prohibit the shipment into this state of any bodies which have not been prepared in accordance with the transportation rules adopted by the American Association of General Baggage Agents.

Resolved further, That the State Board of Health be requested to require of embalmers who are not licensed and who are not privileged to ship certain cases under certain conditions, that they make sworn affidavit that they have prepared such bodies for shipment in the manner provided in the rules for the shipment of certain bodies by non-licensed embalmers.

Resolved, That we reaffirm our approval and confidence in the manner in which the State Board of Health and its executive officer, Dr. H. M. Bracken, have conducted the licensing of embalmers in this state. We are profoundly conscious that the high rank which Minnesota has taken would not have been achieved but for the whole-hearted support of the State Board of Health.

The resolutions were referred to the executive committee with power to act, to report action to the board at its next meeting.

The board decided to distribute 300 copies of the secretary's book on disinfection to the local health officers throughout the state.

Legislative matters pertaining to sanitation to come up before the state legislature at is regular session were referred to the executive committee and the board's attorney.

Dr. Wesbrook presented his quarterly report upon the work of the laboratory. The report was received and the thanks of the board extended to Dr. Wesbrook for the same.

Dr. Wesbrook asked for an expression of opinion from the board as to what special line of work it thought best for the laboratory to follow during the coming year. The board expressed its confidence in Dr. Wesbrook and its wish that the line of special work to be followed in the laboratory during the coming year be left entirely in his hands.

The board authorized the laboratory to collaborate with the Massachusetts State Board of Health or other boards of health in the study of the morphology of diphtheria and other matters pertaining to this disease.

Relating to the veterinary work of the board, Doctors Brimhall and Annand reported upon their work during the past quarter. Matters presented by Dr. Reynolds relative to the shipments of hogs from other states into Minnesota, contrary to the rules of the board; also to regulations governing the testing of horses in the state for glanders; also to revision of the rules pertaining to bovine tuberculosis; also bearing upon certain restrictions upon dogs throughout the country districts of the state to prevent the spread of hog cholera through these agents of transmission, were by motion referred to the executive committee to report to the board at its next regular meeting.

SPECIAL MEETING.

Feb. 6, 1891.

The meeting was called to order by the vice president, Dr. Henry Hutchinson, at 6 p. m.

Present—Drs. Henry Hutchinson, M. H. Reynolds, C. J. Mayo, Edward Shumpik and H. M. Bracken. Certain smallpox bills for the care of state patients were examined and passed upon.

Two bills which had been presented to the legislature bearing upon the destruction of diseased animals were considered, viz., the House bill No. 154; also the bill drawn by Mr. Townley. Neither one of these bills as they stood met with the approval of the board, although a wish was expressed to see partial compensation granted where cattle are tested on account of tuberculosis, or horses killed on account of glanders.

MINUTES OF AN ADJOURNED MEETING.

April 16, 1891.

The meeting was called to order in the office of the Minnesota State Board of health Laboratory, University Campus, Minneapolis, at 10:15 a. m. by the vice president, Dr. Henry Hutchinson.

Present—Drs. Hutchinson, Shumpik, Whetstone, Rowe, Mayo, Reynolds and Bracken. Drs. Wesbrook and Brimhall were present by invitation. The following rules and regulations recommended by the executive committee were approved and adopted:

1. In all ordinary cases of suspected glanders-farcy, first quarantine the suspected animals, then call a competent veterinarian, who shall make such examination and tests as he may deem necessary. The further action of the board shall be largely determined by diagnosis and advice of the veterinarian.

2. All horses, mules or donkeys that are discharging from the nose, or that have had recent sores upon the body, and all animals that have worked as mates with such infected animal must be included in this preliminary quarantine.

3. After Feb. 1, 1901, all horses, mules or donkeys which show positive symptoms of glanders, with or without mallein reaction, must be destroyed without delay.

4. After Feb. 1, 1901, all exposed animals which give one clear reaction to the mallein test, or which show any of the recognized external symptoms of glanders, must be destroyed.

5. All exposed horses, mules or donkeys not showing clinical symptoms of glanders must be placed in quarantine for a period of six months without the mallein test. General use of such animals may be permitted, but they must not be sold, traded or given away during the quarantine period. The quarantined animal or animals must not be fed or watered at any public feeding or watering place.

Provided, however, that if at any time the owner presents to the State Board of Health a certificate of a veterinarian showing that an animal so quarantined has been subjected to the mallein test by a veterinarian approved by the State Board of Health, and that such veterinarian has failed to detect the presence of such disease, then said board may remove the quarantine; and provided further, that in case upon such test such veterinarian certifies that such animal is affected by such disease, then such animal shall be killed forthwith by the Local Board of Health.

Quarantined horses, mules or donkeys shall be inspected by a competent veterinarian, under the supervision of the State Board of Health, once in three months.

Quarantine must not be released in any case until the owner has disinfected the premises as directed by health officers.

In all cases where retests are made, the second dose must be one-half larger than the first.

Carcasses must be destroyed by burning, if practical, otherwise buried under four feet of earth.

VIOLATION OF QUARANTINE DEFINED.

It shall be deemed a violation of quarantine for any person to knowingly remove, authorize or cause to be removed, any animal quarantined on account of glanders-farcy from the farm whereon it is quarantined.

It shall be deemed a violation of quarantine for any person to knowingly cause, authorize or permit to be placed any horses, mules or donkeys, except those hereby quarantined, in any stable or enclosure that is under quarantine on account of glanders-farcy.

The various bills passed by the legislature just adjourned and having a bearing upon sanitary matters were reported upon by the secretary.

Dr. C. H. Mayo, speaking of the county boards of health provided for under Chapter 239, Laws of 1901, thought there should be some regulation or law requiring all counties to have one or more quarantine hospitals. No action taken.

Dr. Shumpik referring to expenses incurred by the state in the care of non-resident smallpox cases moved that hereafter the state shall not pay anything for the construction of quarantine hospitals unless such construction is ordered by the state. Motion was seconded and carried.

Arrangements were made by the board to continue the chemical survey throughout the state, and Mr. Carr was appointed to assist Mr. Carel in this work.

Dr. Bracken suggested that a sanitary engineer be sent to visit the various state institutions and make a report upon the conditions of their sewerage systems and water plants. Dr. Shumpik moved that the suggestion be put in force. Motion was seconded and carried.

Dr. Bracken requested that a director of the Veterinary Department be appointed to fill the place formerly occupied by Dr. Reynolds. No action taken.

Dr. Wesbrook presented a report for the quarter's work in the laboratory. This was approved by the board.

REGULAR QUARTERLY MEETING.

July 9, 1901.

Present—Drs. Whetstone, Shumpik, Stocker, Rowe, Hutchinson, Reynolds and Bracken.

Dr. S. D. Brimhall was, by action of the board, made director of the Veterinary Department. The action of the secretary in em-

ploying Mr. Stebbing to act as an appraiser in the killing of cattle condemned by the tuberculin test, was endorsed by the board. The secretary was also directed to employ Mr. Sinks as disinfector and inspector as necessary from time to time.

In order to aid the Food and Dairy Department in its inspection of dairies, creameries, etc., the Board of Health at this meeting made W. W. P. McConnell, St. Paul, D. B. White, St. Paul, Samuel Haugdahl, New Sweden, H. E. Vroman, Kasson, and W. L. Chappell, Fergus Falls, special sanitary inspectors to serve without compensation.

Authority was also given to Mr. Frank Ziegler, of New Brighton, to act as special inspector during 1901 for the State Board of Health in the quarantine and slaughter of lumpy jaw cattle at New Brighton.

The following resolutions relating to the transportation of the dead were adopted:

Whereas, Certain rules governing the transportation of the dead have been adopted by the conference of State and Provincial Boards of Health, by the General Baggage Agents' Association of America and by the National Funeral Directors' Association;

Whereas, These rules were adopted by these various associations in 1897, thus having allowed ample time for their general adoption, either through the action of state boards of health or legislation;

Whereas, These rules are for the general protection of the public against communicable diseases; as also to prevent the existence of a nuisance, due to the decomposition of imperfectly prepared remains while in transit; therefore be it

Resolved, That after Jan. 1, 1902, the shipment of remains into or from the state of Minnesota must conform strictly to the aforesaid rules.

Resolved, That all non-licensed embalmers shipping remains into or from the state of Minnesota after Jan. 1, 1902, be required to furnish an affidavit to the railroad receiving the remains to the effect that the death of the individual was not due to a communicable disease and that the Minnesota regulations relating to the preparation of the remains of those that have not died of a communicable disease, have been complied with; such affidavit to be forwarded at once by the receiving railroad to the Secretary of the Minnesota State Board of Health.

Resolved, That shipment of remains by non-licensed embalmers into or from the state of Minnesota must always be made in hermetically sealed caskets unless said remains can reach their destination within thirty hours from the time of death of the individual.

Resolved, That a copy of these regulations be sent to the various state and provincial boards of health, the various railroad officials and the embalmers' journals throughout the country.

It was decided to call for a general meeting of local health officers with the State Board of Health (Sanitary Conference). The time and place for such meeting was referred to the executive committee with power to act.

Dr. Brimhall reported that he had met with the officials of the St. Paul and Minneapolis boards of health, as also with the dairy

associations of these cities in an effort to secure some practical plan by which all cows might be tested before they were placed in dairymen's herds. This question was referred to the executive committee with power to act.

The following rules and regulations were adopted by the board:

The importation into the state of Minnesota of range horses, cattle for dairy or breeding purposes, hogs or sheep for breeding purposes, is hereby prohibited, except in compliance with the following rules and regulations:

1. Range horses, cattle for dairy or breeding purposes and hogs or sheep for breeding purposes must be accompanied by a health certificate. Said health certificate shall not be accepted by the state or local boards of health, except when signed by the owner of the animals described in the certificate. and containing his statement to the effect that the described animals have not been exposed to any contagious or infectious disease during the three months prior to the date of certificate. The health certificate shall also contain satisfactory proof that the said animals have been properly inspected, and in case of cattle for dairy or breeding purposes it shall also contain satisfactory evidence of their having been subjected to the tuberculin test and that each and every animal is free from disease.

The inspections and tests must be made by a graduate veterinarian, whose reliability is vouched for by the authority charged with the control of infectious diseases of animals in the state or territory from which the animals come.

2. Local health officers of towns, villages and cities of Minnesota are hereby authorized and instructed to seize and hold in quarantine all live stock as designated in section 1, coming into this state without a legal permit or satisfactory health certificate, and to notify this board, at once, of such action.

3. All animals found in the state of Minnesota, in violation of this order, must be held in quarantine until they can be properly examined by a veterinarian under the authority of the State Board of Health. The expense of quarantine and examination must be paid by the owner or agent of the quarantined animals, as prescribed by law.

It shall be the duty of all persons, corporations and companies to give due and full notice to the State Board of Health of Minnesota, preceding the arrival at the boundary line of Minnesota, of all live stock which come within the provisions of these rules and regulations.

Note.—Blank forms for making out health certificates will be furnished by this board on application.

TO ALL COMMON CARRIERS DOING BUSINESS IN MINNESOTA.

You are hereby notified that by virtue of the power conferred in the act of the legislature of Minnesota, entitled: "An Act to Prevent the Spread of Contagious and Infectious Diseases among Domestic Animals," the State Board of Health of Minnesota is expressly given authority to regulate or prohibit the shipment into this state of any domestic animal which, in the judgment of the said board, may endanger the public health.

By consulting the enclosed rules and regulations of the State Board of Health of Minnesota, and of the U. S. Department of Agriculture, promulgated at the various dates, you will note that they are of particular interest to you as common carriers of live stock. The particular orders of the U. S. Department of Agriculture referred to are under the law creating the Bureau of Animal Industry, approved May 29, 1884, and the recent amendments thereto; Bureau of Animal Industry Order of April 15, 1887; its amendment dated Dec. 13, 1895, and Bureau of Animal Industry Orders Nos. 49, 54, 56 and 57.

Your authority for refusing to ship live stock without certificate may be found in the Bureau of Animal Industry Order, dated Dec. 13, 1895. This prohibits the interstate transportation of animals affected with hog cholera. tuberculosis, or sheep scab, and Order No. 56, dated Dec. 28, 1899, which adds other diseases and other live stock, including horses and goats, to the list. Since transportation companies cannot act as experts in the detection of diseases in the live stock submitted to them for transportation, they may well insist that such stock be accompanied by a health certificate acceptable to the Minnesota State Board of Health.

By co-operating with us in our efforts to secure healthy breeding stock for the farms in this state you will assist in building up the stock industry and materially increase the railroad traffic.

S. D. BRIMHALL, V. M. D.,
Director Veterinary Department.

CIRCULAR OF INFORMATION FOR THE USE OF LOCAL HEALTH OFFICERS RELATING TO TUBERCULOSIS IN CATTLE.

The law now provides that whenever an animal has been adjudged infected with the disease of tuberculosis and has been ordered killed by the State or Local Board of Health such animal shall be appraised at a valuation not to exceed $40.00. The value of the hide and carcass is to be deducted from the amount of appraisal, and the balance is to be paid for, one-third by the state, one-third by the local board and the remaining one-third shall be borne by the owner.

All cases of suspected tuberculosis must be promptly reported to the State Board of Health on blanks provided for that purpose.

The State Board of Health shall be duly notified before any cattle are ordered killed on account of tuberculosis.

All cattle for dairy or breeding purposes brought into this state must be accompanied by a health certificate from a veterinarian whose competency and reliability are certified to by the authority charged with the control of the diseases of domestic animals in the state from which the cattle are shipped. Said health certificate must show that the cattle have been examined and tested with tuberculin and are free from any contagious disease.

It shall also contain the owner's statement that the cattle have not been exposed to anthrax, blackleg, actinomycosis, malignant catarrh, or Texas fever during the preceding three months. Compensation is not allowed for cattle slaughtered on account of tuberculosis, which have not been owned in the state at least one year prior to the date of slaughter.

Milk from creameries should be boiled before use for feeding purposes.

Local health officers of towns, villages and cities of Minnesota are hereby authorized and instructed to seize and hold in quarantine all cattle for dairy or breeding purposes coming into this state without a legal permit or proper health certificate, and to notify the State Board of Health at once of such action. The law provides that whenever any animal is quarantined in transit, the expense of quarantine shall be borne by its owner or keeper.

Note.—Your attention is especially called to the rules and regulations of the Minnesota State Board of Health, for the prevention of the importation of diseased animals into Minnesota. These dules and regulations require that range horses, cattle for dairy or breeding purposes, and hogs or sheep for breeding purposes shipped into Minnesota must be accompanied by a health certificate satisfactory to this board.

S. D. BRIMHALL, V. M. D.
Director Veterinary Department.

REQUEST FROM OWNER TO HAVE HERD OF CATTLE TESTED.

To the State Board of Health, St. Paul,

Gentlemen: I wish to establish and maintain a herd of cattle which is free from tuberculosis, and I wish to have my entire herd inspected and tested with tuberculin and the diseased animals disposed of according to the rules of the State Board of Health.

I understand that this first test is to be made at the expense of the state, and, in consideration of these services, I agree to observe the precautions recommended by your board to keep my herd free from tuberculosis.

My herd includes the following animals: Cows, ...; heifers over one year old, ...; bulls over one year old, ...; steers, ...; calves under one year old, ...; total, ... The cattle are...........
....
(State breed and whether registered.)

Respectfully,
(Signed) ....
(Address) ....

Dr. Wesbrook presented the quarterly report from the laboratory, which was approved.

SPECIAL MEETING.

Aug. 9, 1901.

Present—The entire board in person or by proxy.

The meeting was called to take action relative to a more general enforcement of vaccination. The reasons for such action are set forth in the following correspondence between the secretary of the board and of the office of attorney general:

July 15, 1901.

Hon. W. B. Douglas, Attorney General, St. Paul,

My Dear Sir: Under date of Sept. 12, 1899, you gave an opinion to Hon. J. H. Lewis, then Superintendent of Public Instruction, relative to compulsory vaccination. In that opinion you state that in great emergencies as in cases of a prevailing epidemic, the State and Local Boards of Health can take necessary precautions to prevent the spread of the disease "small-pox," and that they can even exclude from schools pupils not recently vaccinated. This disease is certainly epidemic in the state at the present time. We make biweekly reports to Washington of cases in this state.

Since Jan. 1, 1901, we have reported as follows:

Jan. 14	112	cases
Jan. 28	377	"
Feb. 13	521	"
Feb. 25	457	"
March 11	328	"
March 25	361	"
April 8	424	"
April 22	261	"
May 20	1,161	"
June 3	449	"
June 17	595	"
July 1	527	"
Total	5,573	cases

These cases are largely in country districts. Is it not possible for us to require general vaccination with such a condition prevailing in the warm months?

Very truly,

H. M. BRACKEN.

To this Mr. W. J. Donahower, assistant attorney general, replied as follows:

To your question as to the authority of the Board to make an order requiring all school children to be vaccinated as a condition to their enrollment in the public schools, I would say that in my judgment the board had such a power to make a general order with respect to all children in the public schools, it being generally considered that an epidemic of small-pox is prevalent in the state.

Based upon this reply the following action was taken:

In view of the fact that small-pox is now epidemic, and has been epidemic in the state of Minnesota since 1899, therefore be it

Resolved, That the school boards, school directors and boards of health in the various districts insist upon it that all school children and teachers in the schools of Minnesota, public, private or parochial, must show a certificate of successful vaccination since Jan. 1, 1896, or, in lieu thereof, a certificate from a responsible physician to the effect that the party is immune to vaccination. Such certificate of vaccination or immunity must be presented to the proper authorities on or before Oct. 15, 1901.

Resolved, That all lumbermen, mining superintendents, railroad superintendents or others employing many men, women or children, require a certificate of successful vaccination since Jan. 1, 1896, or, in lieu thereof, a certificate from a responsible physician to the effect that the party is immune to vaccination, as a condition of continuing such employes in service.

The vote upon these resolutions was unanimously in their favor by members of the board who were present and by the proxies of those not present. The full membership of the board was represented in person or by proxy.

The action of the board at this special meeting was reaffirmed by vote at the regular meeting Oct. 8, 1901.

REGULAR QUARTERLY MEETING.

Oct. 8, 1901.

Present—Drs. Stocker, Whetstone, Reynolds, Rowe, Shumpik, Hutchinson and Bracken. Drs. Wesbrook and Wilson also met with the board. The secretary, Dr. Bracken, drew attention to certain rules and regulations that had recently been put in force by the New York City sanitary authorities relative to the collection and care of milk, and suggested that rules and regulations bearing upon this question might well be acted upon by this board. This question was referred to the executive committee to be reported upon at as early a date as possible. Prof. H. L. Russell and State Veterinarian E. D. Roberts, both members of the Wisconsin State Live Stock Commission, were present by invitation to discuss methods by which the importation of glandered horses into the states of Wisconsin and Minnesota might be prevented. No final action was taken on this topic, but it was determined to continue discussion

by correspondence as to plans and methods which should be adopted by the two states.

Dr. Wesbrook's report upon the laboratory work for the preceding quarter was presented, accepted and placed on file.

Dr. Brimhall presented the quarterly report of the Veterinary Department, and this was approved and placed on file. There was also a report from Mr. H. C. Carel relating to the chemical work of the board.

REGULAR QUARTERLY MEETING.

Jan. 14, 1902.

Present—Drs. Rowe, Hutchinson, Shumpik, Stocker, Whetstone, Mayo, Reynolds, and Bracken. Drs. Wesbrook and Brimhall were also present as directors of their respective departments.

The secretary was authorized to name the following physicians to act as inspectors in guarding against the spread of smallpox:

Dr. C. W. Bray, Biwabik.

Dr. J. A. Thabes, Brainerd.

Dr. J. D. Budd, Two Harbors.

Dr. Theodor Bratrud, Warren.

Dr. Henry Grundy, Thief River Falls.

Dr. H. W. Smith, Crookston.

Dr. O. S. Watkins, Carlton.

Dr. D. B. Newman, Bemidji.

Dr. F. L. Wilcox, Walker.

A committee from Edina Mills made complaint relative to the condition of the water at that point in the Minnehaha creek. The sugar beet factory at St. Louis Park was looked upon as the cause of the contaminated water. The second Tuesday in April (the date of the next regular meeting of the board) was set as a time to hear further from this committee, as also from those interested in the beet sugar factory.

Dr. P. D. Winship appeared before the board and described the smallpox condition in the country tributary to Park Rapids. He was given authority to act as an inspector for the State Board of Health, and was instructed to do all in his power to quarantine the smallpox cases and to punish, by legal process, those who concealed the disease or ignored quarantine.

The board adjourned after a morning session only, on account of the sanitary conference, which was to hold its first session on the afternoon of this same date.

ADJOURNED QUARTERLY MEETING.

April 22, 1902.

Present—Drs. Rowe, Shumpik, Reynolds, Mayo, Whetstone, Hutchinson and Bracken.

The election of officers, postponed at the last meeting, was held and resulted as follows:

President, Dr. Franklin Staples; vice president, Dr. Henry Hutchinson; elective members of the executive committee, Drs. E. Shumpik and M. H. Reynolds.

Mr. Carel, chemist of the board, was present to report on conditions at Edina Mills. He asked for an assistant and also that his salary be increased. The matter was laid over for further action at the next meeting of the board.

The representatives from Edina Mills, as also from the beet sugar factory at Hopkins, were present. The question of pollution of Minnehaha creek was thoroughly discussed. The secretary of the board with representatives of the Washburn Home and of the park board, Major Hale and Mr. Harry Jones, had visited the sugar factory at Hopkins the previous Saturday. This delegation could see little reason for any further pollution of Minnehaha creek by the refuse from this factory, *provided* the present plans for the separation and purification of the waste were properly carried out. No action was taken against the factory, but its manager was advised that a close watch would be kept upon the conditions of the creek below the factory when it began operations again. It is but fair to state that Mr. Fink, the manager of this factory, seemed willing and anxious to avoid polluting the creek with the factory's sewage.

RELATIVE TO DISINFECTION.

The Attorney General has given an opinion to the Minnesota State Board of Health which reads as follows:

In reply to yours of April 16th, in which you ask as to the duty of local boards of health in the matter of the disinfection of premises, houses, etc., would say that under the provisions of Section 7055, G. S. 1894, it is the duty of the owner of any house, building, car, vessel or vehicle, to defray the expenses of disinfection when in the opinion of the local board of health such disinfection is necessary. This section contemplates that such disinfection shall be made under the direction of the local board of health, and of course in conformity with the regulations of the State Board of Health. If, however, the local board of health institutes a general scheme of disinfection in the community, designed to prevent the spread of an infectious or contagious disease, in my opinion the expense of such disinfection comes within the provisions of law with reference to the control of an infectious or contagious disease within the community, and, as such, should be met by the county.

The Section 7055 referred to by the Attorney General reads as follows:

When any local board of health are of the opinion that the cleansing and disinfection of any house, building, car, vessel, or vehicle, or any part thereof, and of any articles therein likely to retain infection, would tend to prevent or check infectious diseases, it shall be the duty of such authority to give notice in writing to the owner or occupier of such house, vessel, or vehicle, or part thereof, requiring him to cleanse and disinfect such house, vessel, or vehicle, and the said articles, within a time specified in said notice. If the person to whom notice is so given fails to comply therewith he shall be liable to a fine of not less than twenty-five dollars nor more than one hundred dollars for every day during which he continues to make default, and said board shall cause such house, vessel, or vehicle, and articles, to be cleansed and disinfected, and may recover the expenses incurred, and said fine and costs of prosecution, in a civil action before any justice of the peace or court having jurisdiction in like cases: provided, that where the owner or occupier of any such house, vessel, or vehicle is, from poverty or otherwise, unable in the opinion of said local board effectually to carry out the requirements of said local board in said notice, such authority may, without enforcing such requirements on such owner or occupier, with his consent, cleanse and disinfect such premises and articles, and defray the expenses thereof.

The law referred to by Attorney General Douglas in the last lines of this ruling is found in Chapter 29, Laws of 1902.

The executive committee was instructed to prepare a circular on disinfection. See the following:

REGULATIONS FOR DISINFECTION.

When it is known that a patient is suffering from a contagious or infectious disease, the sick-room should be emptied of all unnecessary furniture, upholstered furniture, hangings, carpets, etc., both for economical and sanitary reasons. If such precautions are taken, there need be but little destruction of property or interference with disinfection when the time for the release of quarantine arrives.

I. *Disinfection of Rooms*—There is no practical gaseous disinfectant that can be used in the sick-room, for gases used for the purpose of producing a germicidal action in the sick-room will kill the patient or patients and attendants. After the removal from the room of one who has been ill with an infectious disease, there should be thorough disinfection of the room and its contents, as follows: All windows and doors, except one for exit for the disinfector, should be closed and sealed by means of strips of paper pasted over the cracks. When all is in readiness to liberate the disinfecting gas, the disinfector should withdraw from the room, closing tightly the door or window through which he makes his exit. If sulphur is to be used as the disinfectant, place a large

wash-tub partially filled with boiling water in the center of the room. In this tub of water place an iron kettle resting upon bricks or some other solid substance. In the kettle place a quantity of crushed brimstone (three pounds for each thousand cubic feet of space in the room), and pour over this some alcohol (about four ounces). When all is ready the disinfector should light the alcohol on the sulphur and withdraw quickly from the room. The water in the tub serves a double purpose: (1) It protects against the danger of fire spreading from the burning sulphur and alcohol in the kettle; (2) It supplies moisture in the room—a necessity with sulphur disinfection. If sulphur is used in a room where there is not an abundance of moisture there is no germicidal action. If sulphur is used where there is an abundance of moisture, the action of the gas generated is very destructive and will injure many things in the room.

Sulphur is, therefore, not a satisfactory disinfectant for household disinfection.

The most satisfactory disinfectant in use at present for rooms is *Formaldehyde.* This gas can be obtained from liquid or solid preparations on the market. A special apparatus is required for the liberation of the Formaldehyde from the various preparations containing it. The liquid preparations generally contain about 35 per cent of the gas in solution; of such solutions twelve, or, preferably, sixteen ounces should be used for each thousand cubic feet to be disinfected.

There should be moisture present in the room undergoing disinfection, and the temperature of the room should be at eighty degrees or more, if possible. The first cost for a Formaldehyde generator is greater than that required for the sulphur burning, but the actual cost of the Formaldehyde required for disinfection is little if any greater than that of sulphur. At the same time it is more efficient and less destructive.

Whether sulphur or Formaldehyde is used, the room disinfected should be kept tightly closed for five or six hours, or even longer if possible.

The Minnesota State Board of Health recommends that Formaldehyde always be used instead of sulphur in the disinfection of rooms.

II. *Disinfection of Contents of the Room*—After the disinfection of the room has been thoroughly carried out as directed above, with Formaldehyde, its contents should be divided into the three groups, as follows:

(a) Articles that can be disinfected by boiling or washing.

(b) Articles that can be disinfected by further treatment with Formaldehyde.

(c) Articles that must be burned.

Washable clothing, sheets, etc., should be placed for a time in a three per cent solution of carbolic acid in water. They should then be removed and placed in boiling water, where they should be kept for at least half an hour.

Certain articles, presenting a free surface, and not too thick, such as carpets, blankets, curtains, etc., can be made comparatively safe by thorough disinfection with Formaldehyde. Furniture that will stand washing, such as plain chairs, tables, bedsteads, etc., should be washed with a solution of corrosive sublimate in water, one part in one thousand. Upholstered furniture, mattresses, pillows, feather beds, and all articles that would be spoiled by such methods of disinfection as have already been described, should be burned.

III. *Further Disinfection of the Room*—After the removal and disinfection of the contents of a room, the room itself should receive careful attention. If the walls are papered, the paper should be soaked off with a one to one thousand parts solution of corrosive sublimate in water, and the walls, windows, woodwork, floors—in fact, everything about the room—should be washed with a similar solution. It is a good plan to repaint all woodwork.

After everything has been thoroughly disinfected, still further precaution should be taken by allowing the most complete ventilation possible in the room for several hours.

Articles of clothing or furniture should be placed in the open air and exposed to the sunlight, if possible, for several days.

The above plan of disinfection should be carried out in all cases after the recovery or death from smallpox, scarlet fever or diphtheria, and it is also advisable after measles and consumption.

It is the duty of the local board of health to supervise disinfection directly or through a duly appointed disinfector.

The law specifically states that the expense of disinfection rests upon the occupant or *owner* of a house, as shown in Section 7055 of the General Statutes of 1894, which is quoted on page 4.

The board of health, therefore, after having superintended the thorough disinfection of a house and its contents, has a claim against the owner or occupier of said house, or in the event of said owner or occupier being too poor to pay for such services, against the county.

IV. *Disinfection of Individuals*—(A) For the person exposed. (B) For the patient.

A. For the person exposed: When it is known that people have been exposed to an infectious disease, they should, if possible, be removed from further exposure and given a disinfecting bath of corrosive sublimate, carbolic acid, or other reliable disinfecting agent. It must be borne in mind that corrosive sublimate should not be used in a metallic bath-tub, unless porcelain lined. After the bath and a complete change of clothing, individuals may be released from quarantine, provided they will stay away from those diseased, and provided they are kept under close observation until the incubation period of the particular infectious disease to which they have been exposed has passed.

B. Disinfection of the patient is for two purposes: (1) His own comfort and safety. (2) Protection of others.

1. When the infection is followed by much superficial inflammation or suppuration, as in smallpox, the use of local disinfectants or antiseptics is indicated for the same purpose as in the surgical care of suppurating wounds—to limit or prevent suppuration.

2. The constant use of disinfectants or antiseptics in the form of baths or lotions may tend to destroy the contagium as it is given off from the body surface and may thus tend to diminish the danger of infecting others.

V. *Disinfection of the Dead*—This is a very important duty; otherwise disease may be spread far and wide. The remains of all those who die of an infectious disease must be thoroughly injected with a reliable embalming fluid; all external orifices must be securely closed with absorbent cotton, and finally the entire surface of the body, including the hair, must be thoroughly cleansed with a reliable disinfectant, such as a solution of corrosive sublimate (one in one thousand parts of water), or of carbolic acid (one in twenty parts of water).

With such precautions taken, the shipment of bodies may be permissible as governed by the American Association rules for the transportation of the dead, *i. e.*, under the supervision of *Licensed Embalmers.*

The importance of giving careful attention to the remains of all who die of an infectious disease cannot be too strongly emphasized.

It is the duty of local boards of health to see that all of the foregoing regulations have been properly carried out.

Dr. Wesbrook presented a report upon the work of the laboratory for the past quarter.

ADJOURNED QUARTERLY MEETING

July 9, 1902.

An adjourned meeting of the board was held at Winona at the residence of Dr. Franklin Staples.

Present—Drs. Staples, Hutchinson, Shumpik, Whetstone, Rowe, Reynolds, Mayo and Bracken.

Drs. Wesbrook and Brimhall were also present, representing their respective departments. The meeting was called to order at 2:45 p. m.

The board had held an informal meeting in the morning and had outlined the work for the afternoon's session, as represented by the following resolutions and motions:

(1) Resolved, That from this date all villages, cities and public institutions contemplating putting in new water plants, or repairing or extending old systems, shall submit to the State Board of Health a statement showing the source from which the water is to be taken and the plans, if any, for purification or filtration of the water.

This resolution was seconded and carried.

(2) Resolved, That from this date all villages, cities and public institutions contemplating putting in new sewerage systems, or repairing or extending old systems, shall submit to the State Board of Health a statement showing the course and place of discharge for all sewage from such systems, and the plans, if any, for the purification or filtration of the sewage.

Seconded and carried.

(3) That legal notice be served upon the Board of Control to abate the nuisance created by the discharge of sewage from the State Hospital at Anoka upon the low ground adjoining the Rum river above Anoka. Also that said board be advised that a sewer from said institution discharging into the Rum river or the Mississippi river will not be permitted by the State Board of Health.

Seconded and carried.

(4) Resolved, That the State Board of Health grant special certificates to dairymen who conform to the requirements of said board with reference to testing of cattle, to care of barn and of milk. That power of such action be given to the Executive Committee.

Seconded and carried.

(5) It was moved, seconded and carried by a rising vote, that the thanks of the board be extended to Dr. and Mrs. Staples and their friends for the courtesies extended to the board while in session in their city.

Dr. Wesbrook and Mr. Carel reported their examination of the water supplies for the Manual Training School at Red Wing and for the city of St. Cloud. Drs. Wesbrook and Brimhall also presented reports from their departments.

VITAL STATISTICS.

It is to be regretted that out state still has such incomplete returns of births and deaths. With our laws as they now are, there should be little trouble in securing full returns. While in many districts the health officers and town clerks secure very complete returns, thus demonstrating the possibility of so doing, in other districts we find quite the reverse, and the incomplete returns in such cases demonstrate the indifference of officials in the discharge of their duties. Thus in one village, after repeatedly writing to the president of the village council, drawing his attention to the fact that the village council had not appointed a legal board of health as required by law, it became necessary to visit the place preliminary to taking legal steps against the village authorities for such negligence. In this instance this personal visit was sufficient to secure satisfactory action on the part of the village council, and the proper reporting of births and deaths from that time on.

Another case illustrating negligence in the reporting of births and deaths comes from the village of ———————. The health officer's attention was drawn to the fact that he had made no returns of births and deaths for his village for 1901. To this he made no reply. The clerk of court for his county wrote me relative to this matter as follows:

> The returns are very incomplete for the county. I know, personally of several births and deaths that have not been sent in, while here in ——————————, one of the most populous villages and towns in the county, the returns only indicate one birth. Is there any way to remedy this? If any record is to be kept it should be as complete as possible. I state the facts as they exist and submit them.

I wrote to the president of the village council as follows:

> Will you kindly advise me as to who is health officer in your village? Our records show that Dr. —————————— has been your health officer, and I have written to him as such, but I am now informed that he has written this office to the effect that he has not been health officer of your village for some time.
>
> We do not receive reports of births and deaths as we should from your village and we are anxious to learn who is responsible for this negligence. Awaiting your reply, I am.

To this came the following reply:

> I find on consulting the village record that Dr. —————————— was elected March, 1900, member of the Board of Health for three years. There are two more members to be elected at the next meeting.
>
> I presume Dr. —————————— can explain why he has not kept the record of births and deaths. I do not feel personally responsible for that matter.

In spite of this statement this office has not as yet received any reports of births and deaths for this village for 1901 or 1902, and has very imperfect records for years prior to these dates. Yet the health officer of this place is a man of good standing in his profession and presumably a law-abiding citizen. This is but one of many examples of negligence throughout the state.

It is hard to understand this indifference with reference to such an important matter. The reporting of births and deaths has a very important legal bearing in the settlement of estates and in other legal transactions where it is necessary to secure proof of relationship. It is a common occurrence for application to be made to this office from some other state, or even from some European country, for a certified copy of a birth or death record, and too often we cannot comply with the request because some local official in time past has neglected his duty, and made no return of such birth or death to us.

The statistical value of such returns is also great.

With our laws as they now stand, we should be among the recognized registration states, but this is not the case. It is to be hoped that a great improvement may be secured in our returns before the time for the next United States census, and that we may then be able to take our proper place among the states that are making complete returns of births, deaths and marriages.

TABLE I.—1900.

Counties.	Total Deaths.	Deaths Due to Preventable Diseases.													
		Pulmonary Tuberculosis.	Other Tubercular Diseases.	Pneumonia.	Bronchitis.	Diphtheria and Croup.	Scarlet Fever.	Measles.	Small Pox.	Whooping Cough.	Cerebro-spinal Meningitis.	Typhoid Fever.	Diarrhœal Diseases of Children (under 2 Years of Age).	Cancer.	Puerperal Septicæmia and Peritonitis.
Aitkin	33	1	1	4	....	3	....	....	....	....	....	2	1	....	1
Anoka	103	12	....	9	1	14	1	....	....	....	....	6	5	8	1
Becker	143	19	1	8	3	4	1	....	....	4	....	12	13	3	2
Beltrami	100	12	....	2	....	8	....	2	....	....	....	5	5	1	1
Benton	113	6	1	8	....	4	....	1	....	4	1	2	14	2	....
Big Stone	64	2	2	4	....	6	....	....	....	....	1	2	4	2	1
Blue Earth	327	29	6	24	7	....	1	....	....	....	....	2	5	23	18
Brown	219	15	3	19	5	4	....	....	....	3	1	1	17	9	3
Carlton	92	5	....	8	5	1	....	....	....	2	2	3	10	4	....
Carver	193	15	2	10	4	4	2	....	....	....	2	4	12	5	3
Cass	11	1	....	1	....	....	....	....	....	1	....	....	1	....	1
Chippewa	102	11	1	6	3	4	....	....	1	4	1	3	7	....	3
Chisago	135	6	1	12	3	12	....	....	....	3	....	3	7	2	....
Clay	143	15	4	6	1	7	1	....	....	....	....	2	10	3	2
Cook	3	....	....	....	....	....	....	....	....	....	....	....	1	....	....
Cottonwood	78	7	2	3	....	2	....	1	....	....	....	2	7	2	4
Crow Wing	135	8	4	15	1	1	1	....	....	3	....	6	12	8	2
Dakota	197	13	1	15	2	8	2	1	....	4	....	2	13	8	1
Dodge	90	6	1	9	1	1	1	....	....	2	....	3	6	5	....
Douglas	189	9	2	22	....	1	1	....	....	2	....	6	20	8	3
Faribault	108	12	....	3	1	4	....	....	....	....	....	2	8	4	2
Fillmore	275	23	1	7	3	2	....	2	....	1	2	4	19	18	1
Freeborn	183	12	....	12	3	9	1	....	....	4	....	4	12	8	4
Goodhue	279	26	4	12	5	7	1	....	1	4	2	8	12	19	3
Grant	63	6	....	2	....	....	1	....	....	2	....	2	8	3	1
Hennepin	190	17	2	8	3	9	1	....	1	....	....	7	12	7	1
Minneapolis	2,501	257	51	184	54	125	16	3	11	6	16	79	144	104	18
Houston	168	13	1	10	3	6	2	1	....	....	....	2	4	7	2
Hubbard	60	2	1	3	....	....	....	....	....	2	....	16	8	1	1
Itasca	26	6	....	2	1	4	....	....	....	....	....	3	....	....	....
Isanti	136	32	....	7	2	13	....	....	....	1	....	5	15	1	....
Jackson	126	6	....	2	1	4	....	....	....	....	....	3	2	....	....
Kanabec	43	2	....	2	....	....	....	1	....	3	....	1	4	1	....
Kandiyohi	166	22	1	8	....	3	....	....	1	2	2	3	18	2	3
Kittson	73	8	1	3	2	4	....	....	....	1	....	2	9	....	....
Lac qui Parle	111	12	1	11	2	2	1	....	....	....	....	1	3	4	....
Lake	66	1	2	9	....	2	2	....	....	....	....	7	4	1	....
Le Sueur	193	9	5	20	6	10	....	....	1	2	1	2	12	4	2
Lincoln	54	5	1	3	....	....	....	....	....	....	....	3	6	4	....
Lyon	101	10	....	3	....	....	....	....	1	....	....	8	7	2	1
McLeod	149	8	1	9	2	13	1	....	....	....	....	2	11	1	2
Marshall	153	20	....	7	1	5	....	5	....	....	....	5	15	4	1
Martin	88	5	....	3	....	5	1	....	....	....	1	4	6	2	1
Meeker	119	23	1	8	4	5	....	....	2	1	....	....	10	6	3
Mille Lacs	70	2	3	3	1	7	2	....	....	....	....	1	4	1	....
Morrison	238	19	1	21	10	4	2	....	....	2	1	6	30	7	2
Mower	206	16	2	15	1	4	....	3	....	....	1	4	5	12	2
Murray	72	4	1	6	2	2	....	....	....	....	....	3	11	2	2
Nicollet	118	5	3	10	2	1	....	....	....	2	....	2	8	7	2
Nobles	100	5	....	9	4	3	....	....	....	....	1	4	3	5	2
Norman	142	26	4	3	1	1	1	....	....	....	....	9	14	5	6
Olmsted	246	23	2	19	5	5	....	....	....	1	....	5	15	20	....
Otter Tail	395	41	1	26	6	6	8	....	2	1	1	21	54	18	6
Pine	102	12	....	2	2	4	....	....	....	2	....	3	13	1	1
Pipestone	51	3	....	1	....	1	....	....	....	....	1	1	4	....	1
Polk	306	31	2	20	1	24	2	1	....	....	....	10	39	9	6
Pope	114	23	1	3	....	1	....	....	1	1	....	1	8	6	1
Ramsey	56	6	1	....	....	2	....	....	....	....	....	....	4	3	....
St. Paul	1,833	197	32	127	42	62	7	2	1	1	10	39	105	94	22
Red Lake	114	4	....	4	1	7	....	....	....	2	1	4	....	4	....
Redwood	128	11	1	10	3	....	6	3	....	4	....	4	16	6	3
Rice	297	20	3	34	5	4	3	....	....	1	5	6	24	14	2
Rock	54	8	1	3	....	2	....	....	....	1	....	1	5	4	1
Renville	216	27	3	10	4	5	....	2	....	12	....	7	13	6	....

TABLE I.—*Continued.*

Counties.	Total Deaths.	Deaths Due to Preventable Diseases. Pulmonary Tuberculosis.	Other Tubercular Diseases.	Pneumonia.	Bronchitis.	Diphtheria and Croup.	Scarlet Fever.	Measles.	Small Pox.	Whooping Cough.	Cerebro-spinal Meningitis.	Typhoid Fever.	Diarrhœal Diseases of Children (under 2 Years of Age).	Cancer.	Puerperal Septicæmia and Peritonitis.
Roseau	72	8	....	....	....	2	....	....	....	1	....	....	12	3	......
Scott	156	13	2	15	2	....	....	....	1	....	1	4	5	5	......
Sherburne	61	3	1	4	1	....	....	....	....	1	....	1	3	3	1
St. Louis	330	11	2	31	....	6	1	1	....	1	....	49	46	3	3
Duluth	820	63	16	77	17	20	1	8	1	....	3	62	91	30	3
Sibley	147	8	2	12	2	4	....	3	....	....	....	4	8	5	2
Stearns	437	38	5	29	12	22	1	8	....	9	1	10	31	14	6
Steele	145	11	1	10	1	1	....	....	....	....	1	3	11	6	1
Stevens	73	9	....	2	....	2	....	3	....	....	....	2	11	1	1
Swift	97	12	....	7	2	2	....	....	....	1	....	7	10	5	......
Todd	122	20	2	13	2	3	1	....	....	5	....	6	20	7	1
Traverse	62	7	1	4	....	1	....	....	....	2	....	1	4	....	1
Wabasha	129	14	....	6	2	2	....	1	....	....	....	1	6	7	......
Wadena	94	7	4	....	....	1	3	....	1	...	1	9	7	3	1
Waseca	128	13	3	7	1	2	....	....	....	2	2	1	13	4	3
Washington	367	22	6	15	8	8	3	....	....	....	....	5	15	5	3
Watonwan	92	11	4	4	1	3	....	....	....	....	1	....	10	4	3
Wilkin	62	3	....	4	....	6	1	....	....	....	....	2	5	1	......
Winona	406	32	7	27	7	14	4	....	....	....	1	14	15	18	1
Wright	279	39	2	18	3	12	....	....	....	4	....	8	18	16	3
Yellow Medicine	132	7	....	6	....	6	....	1	....	4	....	5	16	2	2
State Institutions	316	80	3	10	1	....	....	....	...	....	....	4	....	3	......
Totals	17,236	1,637	227	1,238	289	584	80	54	26	120	66	571	1,267	662	168

TABLE II.—1901.

Counties.	Total Deaths.	Deaths Due to Preventable Diseases.													
		Pulmonary Tuberculosis.	Other Tubercular Diseases.	Pneumonia.	Bronchitis.	Diphtheria and Croup.	Scarlet Fever.	Measles.	Small Pox.	Whooping Cough.	Cerebro-spinal Meningitis.	Typhoid Fever.	Diarrhœal Diseases of Children (Under 2 Years of Age).	Cancer.	Puerperal Septicæmia and Peritonitis.
Aitkin	50	4	....	5	....	....	....	1	....	....	....	1	3	....	3
Anoka	70	4	....	8	1	5	....	....	1	....	....	1	1	1	1
Becker	150	19	1	8	....	9	....	5	1	....	....	8	5	7	1
Benton	65	4	....	3	2	1	3	....	....	....	....	4	4	2	1
Beltrami	74	6	4	7	....	5	....	1	....	....	....	2	4	1	2
Blue Earth	212	14	....	18	4	13	2	....	...	....	....	2	4	10	1
Big Stone	59	6	....	5	....	3	2	....	....	....	1	1	2	4	2
Brown	210	20	1	17	3	2	2	1	....	....	....	1	5	5	2
Carlton	93	8	....	11	4	6	....	....	....	2	2	4	10	1	2
Carver	148	17	2	7	3	5	....	....	3	1	....	2	1	8	2
Cass	117	......	....	4	1	....	....	....	....	....	....	....	2	....	......
Indian Res	9	2	....	......	....	....	....	5	2	....	....	....	....	....	......
Chippewa	123	10	2	8	1	2	....	....	1	....	1	4	5	2	1
Chisago	133	10	3	18	5	2	....	....	....	1	....	5	....	5	1
Clay	174	19	2	13	4	17	....	1	1	....	....	11	4	7	......
Cook	10	4	....	......	....	1	....	....	....	....	....	....	....	....	......
Cottonwood	108	12	1	6	3	4	....	1	....	2	1	2	6	2	1
Crow Wing	143	10	1	18	1	10	....	4	1	1	....	10	11	4	1
Dakota	200	14	1	17	6	7	....	1	....	....	....	2	7	16	......
Dodge	122	12	4	10	1	4	....	....	....	....	....	1	1	2	7
Douglas	151	12	4	9	....	4	1	....	....	1	....	5	....	14	......
Faribault	97	7	1	9	1	2	....	2	1	....	....	2	6	4	......
Fillmore	203	18	3	19	5	2	....	....	....	....	....	4	3	5	......
Freeborn	172	15	4	14	7	2	....	....	....	....	....	1	5	8	1
Goodhue	329	38	5	32	5	3	...	....	....	1	3	1	8	8	......
Grant	60	9	1	4	1	....	1	....	....	1	1	....	3	4	......
Hennepin	197	6	2	11	1	11	....	....	....	....	3	3	4	12	1
Minneapolis	2,778	260	69	208	63	192	12	14	1	21	14	132	132	121	24
Houston	174	18	3	8	2	9	....	....	....	....	1	3	6	3	.. ..
Hubbard	92	3	....	4	3	16	. ..	4	....	4	1	2	5	1	.....
Isanti	108	17	1	11	....	5	....	....	1	....	....	2	5	2	2
Itasca	35	6	1	1	1	2	1	....	....	....	....	2	1	1	......
Jackson	99	10	2	5	2	3	....	1	....	....	1	4	5	3	......
Kanabec	35	......	....	5	1	1	1	....	....	2	....	2	2	....	......
Kandiyohi	174	28	....	10	2	1	....	....	1	....	....	....	6	5	2
Kittson	62	9	....	4	....	3	....	....	....	....	....	2	....	1	1
Lac qui Parle	107	4	2	15	4	3	....	....	....	1	....	1	3	2	1
Lake	62	6	....	6	....	3	....	1	....	....	....	2	4	1	......
Le Sueur	164	7	1	18	2	4	....	....	....	....	2	2	5	2	......
Lincoln	60	8	....	5	1	....	....	....	....	1	....	1	1	3	2
Lyon	115	6	3	6	9	4	....	1	....	....	2	7	4	5	2
McLeod	163	13	1	11	4	7	1	5	1	....	1	2	4	6	1
Marshall	142	19	1	8	1	7	....	....	....	1	1	7	6	4	1
Martin	116	9	....	12	4	1	....	....	....	....	....	1	5	10	2
Meeker	122	14	1	3	3	3	1	1	....	....	....	4	1	7	2
Mille Lacs	54	2	....	5	....	....	1	1	....	....	....	1	1	2	......
Morrison	169	13	1	8	8	2	....	....	....	1	....	6	7	10	2
Mower	174	15	2	11	3	2	....	1	....	....	....	3	9	10	2
Murray	73	2	1	16	....	2	2	....	....	1	....	2	1	1	......
Nicollet	154	10	1	11	4	4	....	1	....	....	....	....	4	5	1
Nobles	112	8	3	20	1	2	....	1	....	....	1	2	4	4	1
Norman	108	15	....	3	2	8	....	....	1	....	....	2	4	5	......
Olmsted	260	25	6	27	3	....	1	....	....	2	1	3	2	12	2
Otter Tail	401	42	5	21	5	23	3	1	1	4	....	16	5	16	1
Pine	96	4	1	6	1	10	....	3	2	1	....	3	4	1	......
Pipestone	63	3	3	8	....	....	....	....	....	3	....	2	3	2	......
Polk	261	40	1	24	6	8	1	1	1	10	2	12	7	8	1
Pope	99	13	2	5	1	2	1	....	....	....	....	1	3	2	3
Ramsey	66	5	1	3	1	3	....	....	1	....	....	1	4	1	1
St. Paul	1,906	199	35	144	39	50	13	14	1	5	10	24	103	78	11
Red Lake	105	10	....	10	3	2	....	1	1	2	....	5	2	2	......
Redwood	137	8	1	13	4	7	1	....	2	1	....	1	8	3	2
Rice	263	22	3	19	8	11	2	....	1	....	1	4	9	9	......
Rock	57	5	1	4	3	2	1	....	....	....	....	....	....	2	3

TABLE II.—*Continued.*

Counties.	Total Deaths.	Deaths Due to Preventable Diseases. Pulmonary Tuberculosis.	Other Tubercular Diseases.	Pneumonia.	Bronchitis.	Diphtheria and Croup.	Scarlet Fever.	Measles.	Small Pox.	Whooping Cough.	Cerebro-spinal Meningitis.	Typhoid Fever.	Diarrhœal Diseases of Children (Under 2 Years of Age).	Cancer.	Puerperal Septicæmia and Septicæmia.
Renville	177	20	7	10	7	4	....	....	2	....	....	2	10	5	2
Roseau	72	4	1	4	....	7	....	....	....	....	....	1	2	1	......
Scott	142	11	4	12	2	2	1	1	....	....	3	1	2	6	......
Sherburne	51	8	....	5	3	8	....	....	....	1	....	....	1	2	......
St. Louis	289	14	4	30	7	12	....	....	1	....	5	16	35	1	2
Duluth	767	66	19	56	19	32	2	3	1	2	9	35	74	26	8
Sibley	157	13	1	13	2	5	1	....	....	1	1	2	3	8	1
Stearns	373	46	6	20	7	13	5	....	....	4	....	13	8	11	4
Steele	153	13	....	18	4	5	....	7	....	....	2	7	3	7	......
Stevens	67	7	2	8	1	3	....	....	....	....	....	2	3	2	......
Swift	108	10	....	5	4	2	....	....	....	1	....	5	4	5	1
Todd	140	12	4	14	2	....	3	....	....	1	....	1	8	4	......
Traverse	51	3	....	6	....	1	1	....	1	....	....	....	3	4	1
Wabasha	113	10	....	5	6	6	2	2	1	....	....	1	3	8	......
Wadena	86	4	....	8	2	4	....	2	....	1	1	2	2	3	......
Waseca	114	10	1	7	3	1	1	1	....	2	....	4	8	2	......
Washington	257	25	6	16	7	10	1	....	....	....	....	3	9	10	1
Watonwan	84	11	1	6	5	2	....	....	....	....	....	1	2	4	3
Wilkin	79	8	....	8	3	2	1	....	....	....	....	15	4	....	......
Winona	396	28	6	26	5	15	3	1	3	3	2	4	16	15	1
Wright	279	19	3	30	3	14	....	1	....	2	....	4	11	13	1
Yellow Medicine	117	15	2	5	1	3	....	2	....	2	2	....	6	....	......
State Institutions	310	67	3	2	....	....	....	1	....	....	....	3	....	3	......
Totals	16,927	1,492	264	1,293	345	686	75	94	40	94	74	466	696	631	120

TABLE III.

Mortality in State Institutions.

	1900.							1901.						
	Total Deaths.	Pulmonary Tuberculosis.	Other Tubercular Diseases.	Pneumonia.	Bronchitis.	Typhoid Fever.	Cancer.	Total Deaths.	Pulmonary Tuberculosis.	Other Tubercular Diseases.	Pneumonia.	Bronchitis.	Typhoid Fever.	Cancer.
Hospital for Insane, Anoka........	2	....	....	....	....	....	....	5	....	....	....	....	....	1
Hospital for Insane, Hastings	4	1	....	....	....	....	....	3	1	....	....	....	....	....
Hospital for Insane, Rochester....	83	8	2	3	1	....	....	92	12	....	2	....	....	2
Hospital for Insane, Fergus Falls..	101	28	1	5	....	....	2	99	29	1	....	....	1	....
Hospital for Insane, St. Peter	76	17	....	....	....	4	....	79	15	....	....	....	2	....
School for Defectives, Faribault...	40	12	....	1	....	....	....	*31	10	1	....	....	....	....
State Prison, Stillwater...........	6	3	....	....	....	....	1	1	....	1	....	....	....	....
School for Dependents, Owatonna	4	1	....	1	....	....	....	....	....	....	....	....	....	....
Totals..........................	316	70	3	10	1	4	3	310	67	3	2	....	3	3

* One death due to Small Pox.

TABLE IV.

Years.	Total Deaths.	Deaths Due to Preventable Diseases.													
		Pulmonary Tuberculosis.	Other Tubercular Diseases.	Pneumonia.	Bronchitis.	Diphtheria and Croup.	Scarlet Fever.	Measles.	Small Pox.	Whooping Cough.	Cerebro-spinal Meningitis.	Typhoid Fever.	Diarrhœal Diseases of Children.	Cancer.	Puerperal Septicæmia and Peritonitis.
1890..	14,492	1,291	180	924	272	977	165	88	....	92	46	418	1,077	339	146
1891..	14,714	1,268	198	897	333	908	205	136	....	224	55	534	1,126	328	133
1892..	14,673	1,301	167	951	313	885	300	88	....	159	37	404	914	396	131
1893..	14,969	1,333	208	872	292	763	243	43	....	80	80	564	1,248	419	123
1894..	14,686	1,462	182	723	243	679	224	64	5	135	42	535	1,247	404	94
1895..	15,418	1,493	200	1,036	322	721	108	73	....	226	47	567	1,241	476	105
1896..	14,462	1,486	175	971	214	663	63	137	....	165	42	448	834	514	105
1897..	13,945	1,449	170	743	246	393	44	28	....	69	27	423	885	514	86
1898..	15,279	1,483	221	1,125	227	378	47	264	....	72	165	389	745	570	104
1899..	15,340	1,483	220	1,047	240	333	51	44	9	127	174	320	647	552	66
1900..	17,236	1,637	227	1,238	289	584	80	54	26	120	66	571	‡.....	662	168
1901..	16,927	1,492	264	1,293	245	686	75	94	40	94	74	466	......	631	120

‡ Up to 1900, under diarrhœal diseases of children the age of *5 years* was the limit. Theer was also a group of cases described as "not specified." Beginning with 1900 the age limit for deaths described as due to diarrhœal diseases of children is limited to *2 years* and the indefinite "not specified" group, which applied largely to children under 2 years of age, has been abolished.

PREVENTABLE DISEASES.

The preceding Tables I.-IV. show:

(a) The total mortality throughout the state.

(b) The mortality from preventable diseases.

Table I. Data for the year 1900.

Table II. Data for 1901.

Table III. Data for state institutions in both 1900 and 1901.

In 1900 the total deaths were 17,236. Of these 6,989, or about 40 per cent, were due to preventable causes.

In 1901 the total deaths were 16,927, and of these 6,370, or about 38 per cent, were due to preventable causes.

In the state institutions the total deaths for 1900 were 316, and of these 91, or about 29 per cent, were due to preventable causes. In 1901 there was a total of 310 deaths in these institutions with 78, or 25 per cent, due to preventable causes. Two facts are strikingly noticeable from the foregoing summary. First, the large percentage of deaths due to preventable causes; second, the fact that in state institutions the percentage of deaths due to preventable diseases is much smaller than that for the state at large, and this in spite of the fact that the population of these institutions is far inferior as to physical condition to the population of the state at large. This speaks favorably for their management.

To carry this comparison a little farther: the mortality from tuberculosis alone in the state at large was about 10.8 per cent in 1900, and 10.4 per cent in 1901; while in the state institutions it is 23 per cent and 22.6 per cent respectively for the same periods. This is as should be expected, not because infection from tuberculosis is greater in the state institutions, but because a large percentage of those going to such institutions are infected at the time of their entrance. With this one disease eliminated the percentage of deaths from other preventable diseases is still more markedly in favor of the state institutions, for it then stands as follows:

State at large, deaths from preventable diseases, not including tuberculosis, 1900, 29.7 per cent; 1901, 27.3 per cent.

State institutions, deaths from preventable diseases, not including tuberculosis, 1900, 5.7 per cent; 1901, 2.6 per cent.

Of course, conditions have to be taken into consideration that would explain to some degree this great discrepancy between the statistics from the state at large and the institutions, but such

would not entirely remove this contrast. These facts tend to prove: (1) that preventable diseases can be prevented; (2) that special attention must be given to the care of tuberculous in state institutions.

Before taking up the study of individual diseases it will be well to refer to Table IV. on page 152.

The percentage of deaths from any one cause compared with the total deaths has not changed materially during the twelve years covered except in the case of diphtheria, which steadily declined up to 1900; diarrhoeal disease of children, which has gradually declined to date; and cancer, which has apparently increased.

TUBERCULOSIS.

This, a preventable disease, has received entirely too little attention in this state up to the present time. It is a common thing for a single living leper in a community to cause a panic, yet leprosy is as nothing compared to this disease.

The records in this state during the past twelve years show that more than ten per cent of all deaths each year have been due to tuberculosis. See Table IV., page 152. The deaths in localities are given in Tables I. and II., pages 148-151. The high mortality from this disease in state institutions is shown in Table III., page 152.

This latter is due largely to the physical condition of the inmates, but in part, it must be admitted, to institutional infection due to lack of isolation of those diseased. Such conditions are dependent upon overcrowding and not upon lack of appreciation, by those in charge, as to the importance of isolation.

The question of establishing sanatoria for the tuberculous is under consideration at the present time in many states, and our own legislature, at its next session, will undoubtedly take some action upon the report of the commission appointed by the legislature in 1901 to investigate the necessity for such institutions.

In considering the care of the tuberculous there are three questions involved:

(1) The care of the curable.
(2) The care of the incurable.
(3) Protection of the healthy from infection.

The first is an important work, and is well illustrated at the state institution at Rutledge, Mass. The cases cared for are carefully selected, only those individuals being received who are in the early stages of the disease. The results as shown by the recovered cases are most satisfactory.

This institution has accommodation for 250 patients. The weekly maintenance for each patient was $9.74½ in 1900 and $9.47 in 1901.

During the year Sept. 30, 1900, to Sept. 30, 1901, 575 patients were cared for (the capacity for this period was for 200 patients), the daily average being 168.

The result of treatment at this sanatorium shows that in the first year 64 per cent, in the second year 64½ per cent, and in the third year 76 per cent of all grades of incipient cases were apparently cured or arrested.

The good work of this institution is not limited to the actual care of resident cases. Its educational influence is far reaching. The patients who go home with the disease arrested or cured have learned how to take care of themselves. Their methods are noted and followed by others who may not have been able to gain entrance to the sanatorium, and these, too, derive some benefit from such scientific methods used in the care of this disease.

The establishment of State Sanatoria for the care of the tuberculous is most commendable, but at present it does not go far enough in the effort to control this disease. Massachusetts was able to care for 482 patients at Rutledge in 1900. The same year that state had 4,390 deaths from tuberculosis. The sanatorial care of 482 incipient cases in a state, showing such a high death rate from this dread disease, is but a beginning. The same year Minnesota had 1,864 deaths from this same disease, but up to the present it has no sanatorial treatment for this class of patients. The Province of Ontario in 1900 passed an excellent law providing for the establishment of *Municipal* Sanatoria for Consumptives. In this, provision was made that the Province should pay a proportion of the cost and maintenance of such institutions. This is wise, for it encourages the establishment of *many*, rather than of a few, such institutions, the same being near the homes of the patients, a great desideratum. Still further, the conditional aid of the Province is an incentive to municipalities to undertake a work that otherwise might not receive their sympathy and support.

The Massachusetts Sanatorium at Rutledge is for the benefit of the *incipient* cases, and this is true of most of the state institutions. In planning for the care of the tuberculous we must not forget the incurables. They demand our consideration for two reasons: (1) The protection of their uninfected associates, (2) their individual comfort. The former is a utilitarian problem, the latter a humanitarian duty.

Looked at from the most selfish standpoint it is bad policy to leave the incurables where they can infect others. It is an unprofitable investment for a state or municipality to permit a poor consumptive to remain in close association with other members of the family, for the infection will in all probability be spread by such a procedure and the lives of others be sacrificed. It is permissable to leave a tuberculous patient at a home where it is possible to carry out the necessary sanitary methods to prevent the infection of others, such as sleeping alone, disinfection of sputum and excreta, control of sputum and excreta, and general cleanliness. But the duty of removal of tuberculous patients is absolute where such an individual is living in a small house with probably not more than one or two sleeping rooms for the entire family and each bed occupied by two or more persons.

Looked at from the humanitarian standpoint, it is certainly the duty of some one to provide a suitable home and comforts for the suffering tuberculous indivdual condemned by the nature of his disease to a slow and painful death. What is more pitiful than a tuberculous outcast? And yet how many of them are to be seen in all parts of the country. The private and church hospitals do not want them, and many of the municipal hospitals refuse them lodgment or grant them a home grudgingly. Compare the wards set aside for the tuberculous in certain hospitals with the wards used for other medical, or for surgical, cases. It will readily be seen that the tuberculous individuals have scant attention. From every point of argument, therefore, there is a demand for sanatoria and hospitals for the tuberculous, to give opportunity for recovery to the curable, to protect the non-infected, and to make the journey to the grave endurable for those for whom there is no hope.

In October, 1901, the idea suggested itself to me of trying to secure data somewhat specific in nature bearing upon deaths due to tuberculosis. I therefore had the following blank prepared, and one of these has been sent to the last attending physician when a death from tuberculosis has been reported to this office.

MINNESOTA STATE BOARD OF HEALTH.

Information Relating to Death from Tuberculosis.

A. *Patient:*

Name.............................. Age ....

Date of death....................Place of death...........

Occupation..............................

Duration of disease........How long confined to house?......

Was there a period of apparent recovery?...........If so, of how long duration and due to what cause?.........................

Probable source of infection..............................

What part of body was first affected?......................

Was case examined bacteriologically?.....If so, by whom?.....

Was there any climatic or sanatorial treatment?..............

Were there previous known cases of tuberculosis in this family?...............................

Was patient isolated?........If so, at what stage?..........

Were sputum and excreta disinfected?.......................

B. *Other Members of the Household:* Number.........

Ages ....

Condition as to health of each..............................

Relation of patient to inmates of house....................

C. *House:*

Describe location (high or low ground; also nature of soil)......

Is there a cellar?.......If so, describe condition.............

Give material of house (wood, stone or brick)................

Describe finish of walls in room occupied by patient...........

Give approximate size of house............................

State number of floors........Give number of rooms.........

Give plan for each floor on the back of this sheet; indicate room or rooms occupied by patient.............................

When was the house built?......Present condition..........

Has the house been disinfected since the death of the patient?

....

Were there previous known cases of tuberculosis in this house?

....

Is this a rented house or owned by the residents?............

Name of reporter.......................

Address ....

(Give on the other side a diagram of the house and indicate rooms in which patient was ill.)

I have already received over five hundred returns upon these blanks. In some cases the information given is unavoidably meagre. In a few cases physicians have given brusque replies and have refused to fill out the blanks; still other physicians have paid no attention to the blanks sent them. The greater number have given as complete returns as possible, and these deserve the thanks, not only of this board, but of the profession and public at large, for they have thus greatly aided in giving a substantial basis for statistics as bearing upon this disease.

From data thus given, I have constructed Tables V. and VI. After due allowance is made for errors in diagnosis for some of these cases there is still much valuable information in these two tables.

The *case numbers* in Tables V. and VI. are the same. It is therefore possible to secure more complete data for any given case in VI. by referring to Table V.

In V. I have tried to show the relation of the final illness to the duration of the disease; also the possible source of infection. It would seem from the reports upon the disinfection of sputum, excreta, and rooms that not enough attention is given to this matter.

In Table VI. certain points given in V. are still retained. The chief purpose of this table is to show the prevalence of the disease by decades; also the type of the disease and the probable source of infection for the different ages. The parts involved and the nature of the infection during the first decade of life is in marked contrast with those set forth in the third and fourth decades. It is to these latter and most highly fatal decades that we should give special attention.

Undoubtedly, there are several deaths recorded as due to tuberculosis among those ranging in age from fifty-one years upward that should have been charged to some other cause. It may be but a coincidence, but it is nevertheless worthy of note, that during the first decade the mortality is greater for males; during the second, third and fourth decades for females; for the fifth decade the mortality is again greater among males. Above the age of sixty the rate of mortality is about equally divided between the two sexes. It is fair to presume that for the first decade the higher mortality for males is purely accidental, and would in all probability not be borne out by a large series of cases. I cannot believe that male children are more liable to infection during infancy than females.

It is not surprising that the mortality from tuberculosis is much higher for females than males during the second decade, although the general manner of living for both sexes, is quite similar during this period, for undoubtedly the physical strain is greater upon the female than the male in passing from childhood through puberty to adult life. The higher mortality for the female during the third and fourth decades is, as we would naturally expect it to be, due in part, at least, to the greater danger from infection because of an indoor life, the care of tuberculous patients, etc. Whether a long series of cases would bear out the showing of a higher mortality amongst males in the sixth decade may be an open question, but it is about what we would expect, for at this time a certain number of men break down physically, lead more of an indoor life, and thus through greater susceptibility and increased exposure to infection due to environment, a greater number become victims of this disease. On the other hand, a larger percentage of susceptible females than of males have been removed during the second, third and fourth decades. For those over sixty years of age there is no apparent reason for any marked difference in the mortality from this disease as governed by sex, and the table seems to bear this proposition out, although the number recorded is entirely too small to permit of drawing any definite conclusions.

TABLE V.

Record of 420 Cases of Tuberculosis, 1901-1902.

Case.	Sex.	Age.	Occupation.	Duration.	Confined to House.	Parts Involved.	Bact. Ex.	Source of Infection.	Previous Cases in Family.	Previous Cases in House.	Sputum or Excreta Disinfected.	Room Disinfected after Death.
1	F	27	Housewife	6 months	5 weeks	Lungs	No.	Heredity	Yes	No	No	No
2	F	32	Housewife	?	2 weeks	Lungs	No.	?	Don't know		No	
3	F	38	Housewife	2 years	2 months	Lungs	Yes.	?	Yes, 2 sisters died		No	No
4	M	42	Laborer	2 years	2 months	Larynx	No.	?	No	No	No	Yes
5	M	50	Street sweeper	3 months	3 weeks	Lungs	No.	Street sweepings	Not known	Not known	No	No
6	M	33	Farmer	3 years	1 week	Lungs	No.	Mother	Yes	Not known	Yes	No
7	F	17	School girl	6 months	6 weeks	Lungs	Yes.	Family?	Yes	Yes, 3	Yes	Yes
8	F	35	Housekeeper	7 months	2 months	Lungs	Yes.	Mother	Yes, mother	Yes, 1	Yes	Advised
9	F	29	Housewife	9 months	1 month	Lungs	No.	?	Yes, mother	Not known	Yes	Yes
10	F	18	Housewife	1 year	1 month	Lungs	Yes.	Exposure	No	No	Yes	Yes
11	M	39	Farmer	7 years	1 day	Lungs	No.	Exposure	No	No	No	
12	M	68	Farmer	1 year	3 months	Lungs	No.	Not known	No	Hospital	Yes	Yes
13	M			1 month+		Intestines	No.					
14	F	26	Housewife	1 year	6 months	Lungs	No.	Not known	No	No	No	No
15	F	46	Housewife	1 year	4 months	Lungs	Yes	Not known	No	No	No	Yes
16	M	1	Child	4 weeks	4 weeks	Lungs	No.	Not known	Not known	Not known	No	?
17	M	26	Press feeder	2 years	6 weeks	Lungs	Yes.	After typhoid fev	No		Yes	
18	F	26	None	1½ years	6 weeks	Lungs	Yes.	Foll'ng la grippe.	Yes, bro. now ill.	Not known	Yes	?
19	M	5mo.	Child	5 months	5 months	Intestines	No.	Mother	Yes, mother	No	No	No
20	F	70	Housewife	?	1 week	Lungs	No.	Not known	No	No	No	No
21	M	54	None	?		Lungs	No.	Not known	Not known	Yes	No	No
22	M	42	Tailor	Sev. years	6 months	Lungs	Yes.	Not known	Not known	Not known	Yes, sput.	No
23	M	3	Child	3 weeks	3 weeks	Neck glands	No.	From milk?	No	No	No	No
24	F	13mo	Child	6 months		Lungs	No.	Not known	No	No	No	No
25	F	59	Housewife	5 years	1 year	Lungs	No.	Not known	Yes	No	Yes	?
26	F	34	Washing	2 months	2 months	Axilla, neck, groin gl'ds	Yes.	Not known	Yes, sister	No	Yes, sput.	No
27	M	37	Driver Ex. Co.	3 years	2 months	Lungs	No.	Not known	Not known	Not known	Yes	?
28	M	24	Laborer	?	6 months	Lungs	No.	Not known	No	No	No	?
29	F	42	Housewife	2 years	2 years	Lungs	Yes.	Not known	No	No	Yes	?
30	M	41	Saloonkeeper	?	2 months	Intestines	No.	Not known	No	No	No	?
31	M	6	Child	4 weeks	18 days	Meninges	No.	Not known	Yes, moth.'s cous.'s ch l			
32	M	30	Laborer	?	?	Lungs	No.	Not known	Not known	Not known	No	?
33	F	3mo.	Infant	3 months	3 months	Cerv. glands	No.	Father	Yes, fath. & his bro. & sis.	Yes, hip joint case	No	Yes
34	F	19	Housewife	1 year	6 months	Rectal lymph —	No.	Following typh'd	No		Yes	
35	M	43	Farmer	2 years	6 months	Lungs	Yes.	Not known	No	No	Yes	Yes
36	F	13	School girl	1 year	3 months	Lungs	Yes.	Not known	No	Not known	Yes	?
37	M	57	Teamster	2 years	6 months	Intestines	Yes.	Not known	No	No	Yes	No
38	F	18		18 months	1 month		No.	Not known	Yes	No	No	No
39	M	13	School boy	6 months	2 weeks	Lungs	No.	Parochial school	No	No	No	No

40	M	27	Hardware clk.	1 year	1 week	Lungs	No.	Dissipation	Yes, mat. grandmother.	No.	No.	No.
41	M	46	Painter	2 months	1 month	Lungs	No.	Not known	No.	No.	No.	Yes.
42	M	20	Laborer	2 years	1 month	Lungs	No.	Not known	Not known	Yes.	No.	Yes.
43	M	34	Laborer	1 year	10 months	Psoas abscess	No.	Not known	No.	Yes, Red Cross Hospital.	Yes.	Yes.
44	M	58	Laborer	7 months	4 weeks	Lungs	No.	Not known	No.	Yes.	Yes.	Yes.
45	F	20	Housewife	1 year	8 months	Lungs	Yes.	Not known	No.	No.	No.	No.
46	M	21	Laborer	Sev. months	4 weeks	Lungs	No.	Not known	Yes, mother	Yes, mother	No.	No.
47	F	13	School girl	1 month	1 month	Lungs	No.	Following diph.	Yes, fath. & moth	Yes.	No.	Yes.
48	M	25	Stenographer	1 year	3 months	Lungs	No.	Office?	Yes, distant rel.	No.	Yes.	Yes.
49	F	30	Domestic	2 years	7 weeks	Intestines	No.	Not known	No.		Yes.	
50	M	15	School boy		12 days	Abdominal gl'ds.	No.	Not known	No.	Not known	No.	
51	M	28		3 years		Lungs	Yes.	Not known	Not known	Hospital	Yes.	
52	F	58	Housewife	1 year	3 months	Lungs	No.	?	No.	No	Yes.	Yes.
53	M	38	Laborer	2 years	6 months	Lungs	Yes.	Not known	Not known	Not known	Yes, sput.	Yes.
54	F	73	Housewife			Lungs	No.	?	No.		Yes, sput.	No.
55	F	19	F'ble M'ded Sc.	3 months+.	13 days	Lungs	No.	School	In school, yes	Yes.	Yes.	Yes.
56	F	22	Artist	18 months	3 weeks—	Lungs	Yes.	Not known	Not known	Not known	No.	Yes?
57	M	19	None	?	1 month	Lungs	Yes.	Not known	Not known	Not known	No.	Yes?
58	F	22	Housewife	10 months	4 months	Lungs	Yes.	?	No.	Not known	No.	Yes.
59	M	30	Telegraph op.	4 years	6 months	Lungs	Yes.	Not known	Probably	Not known	Yes, at hosp'l	Don't know.
60	M	59		2 years	3 months	Lungs	Yes.	Not known	No.	No.	Yes.	Don't know.
61	F	54	Housekeeping	7 months	1 week	Lungs	Yes.	Foll'g pneumonia	No.	No.	Yes.	No.
62	F	41	Housewife	2 years	2 months	Lungs	No.	Not known	No.	No.	Yes.	Yes.
63	M	28	Lawyer	1½ years	Not at all	Lungs	Yes.	Not known	Yes.	Yes.	Yes.	Yes.
64	F	17	Teacher	6 months	3 months	Lungs	No.	Not known	No.	Don't know	Yes.	No.
65	M	2	Child	6 weeks	10 days	Brain	No.	?	G'dmother died in same h'se 2 mo bef., pul tuber.	Yes, gr'dmother.	No.	No.
66	F	75	Housekeeper	18 months	2 months	Lungs	Yes.	Not known	No.	No.	No.	No.
67	F	21	None	1 year	2 months	Lungs	No.	Sister	Yes, sister	Yes.	Partially.	No.
68	M	68	Miller	1 year	1 month	Lungs	No.	?	No.	No.	Yes.	No.
69	F	44	Housewife	3 years	3 weeks	Lungs	Yes.	Not known	Yes, form. wife of husb.	No ?	Yes.	Yes.
70	F	37	Housewife	5 years		Tarsal bones	No.	Not known	No.	Hospital	Don't know.	Don't know.
71	F	38	Housewife	1 year	3 months	Lungs, larynx & intest.	No.	Not known	No.	No.	Yes.	Yes.
72	M	34	Saloonkeeper	6 months	2 months	Lungs	No.	Not known	No.	Not known	Yes.	No.
73	M	26	Printer	2½ years	10 days	Lungs		Not known	No.	No.	Yes.	Advised.
74	M	14	Laborer	½ year	2 months	Lungs	Yes.	Not known	No.	No.	Yes.	Yes.
75	M	44	Grocery clerk.	Sev. years	3 months	Lungs	No.	Not known	Not known	?	Yes.	?
76	M	20	Farmer	3 months	1 month	Tub. glands neck	No.	Not known	Yes.	No.	No.	No.
77	F	19	Clerk	11 months	8 months	Lungs	No.	Not known	Yes, 3 fath.'s fam	No.	Yes.	No.
78	F	27	Housewife	2 years +	2 months	Lungs	No.	?	?	?	No.	?
79	M	25	Laborer	3 years	3 months	Lungs	Yes.	Not known	Not so far as k'n.	No.	Yes.	Yes.
80	M		Farmer	6 months	2 months	Lungs	Yes.	Not known	Yes, a brother		Yes.	Yes.
81	F	37	Housewife	1 year	6 months	Lungs	Yes.	Not known	No.	No.	Yes.	Yes.
82	M	27	Printer	3 years	Few weeks.	Lungs	Yes.	Father and bro's	Yes, fath. & 2 bro.	No.	Yes.	No.
83	F	28	Housewife	8 months	2 months	Lungs	Yes.	Following a cold.	Brother & moth.	No.	Yes.	Yes.
84	M	30	Farmer	3 years	6 weeks	Lungs	Yes.	Not known	Parents, 2 sis., 2 broth.	Yes.	No.	No.
85	F	18	Housework	1 year	4 months	Lungs	No.	Not known	No.	No.	No.	No.
86	M	48	Farmer	20 years	2 weeks	Lungs	No.	Never fully recov. pneu.	No.	No.	Yes.	Yes.
87	F	32	Housewife	3 years	1 month	Lungs	No.	Not known	No.	No.		No.
88	F	27	Domestic	5 years	18 months	Bladder & lungs.	Yes.	Not known	No.	No.	Yes.	Yes.
89	M	19	Farmer	1 year	2 months.	Pleura	Yes.	Not known	Yes, aunt	No.	Yes.	No.
90	F	18	None	1 year+	3 weeks	Stomach	Yes.		Yes.	No.	Yes.	Yes.

TABLE V.—Continued.

Case.	Sex.	Age.	Occupation.	Duration.	Confined to House.	Parts Involved.	Bact. Ex.	Source of Infection.	Previous Cases in Family.	Previous Cases in House.	Sputum or Excreta Disinfected.	Room Disinfected after Death.
91	F	33	Housewife	6 years	10 months	Lungs	Yes.	Not known	2 cousins, Norw'y	No	Yes	Yes
92	F	28	Housewife	14 months	4 months	Lungs	Yes.	Sisters	3 sisters, 3 broth.	Yes, 1900	Yes	Yes
93	F	17	Domestic	14 weeks	8 weeks	Lungs	Yes.	Not known	Father, 2 sisters.	No	Yes	Yes
94	M	39	Merchant	8 months	2 months	Lungs	Yes.	Not known	No	No	Yes	Yes
95	F	22	Housewife	8 months	1 month	Lungs	No.	In family	Yes	Yes	No	No
96	M	35	Train hand	3 years	9 weeks	Lungs	No.		No	Not as far as k'n	Yes	No
97	M	39	Bookkeeper	18 months	3 months	Lungs	No.		No	No	Yes	Yes
98	F	52	Housewife	2 years	3 months	Lungs	Yes.	Her home	Yes, 2 daughters.	Yes	Yes	Yes
99	M	36	Farm laborer	2 years	10 days	Lungs	No.	Roommate	No	No	Yes	Yes
100	F	....				Lungs		Child	Yes, child	Yes, child	No	No
101	F	35	Housewife	1 year	2 months	Lungs	Yes.	Foll'ed la grippe.	No	No	Yes	Yes
102	M	25	Merchant	1 year	2 months	Throat	Yes.	Aunt	Yes, aunt	No	Yes	Yes
103	F	46	Housewife	4 months	4 months	Lungs	Yes.	Not known	No	No	Yes	Yes
104	F	40	Housewife	2 months	5 weeks	Lungs	No.	Not known	Yes, brother	No	Yes	Yes
105	F	22	Housewife	2 years	6 months	Lungs	No.	Hereditary	Yes		Yes	
106	F	39	Housewife	13 months	2 months	Lungs	No.	Not known	No	Not asknown	Yes	Yes
107	M	26	Bookbinder	Few weeks.		Testicles	No.	Not known	Not known	In St. Mary's Hos	Yes	
108	F	17	Farmer's d't'r.	6 months	3 weeks	Lungs	No.	Family	Yes	Yes	Partially.	No
109	F	20	Store	1 year +	3 months	Lungs	No.	Brother	Yes	Yes, brother	Yes	Yes
110	M	63	Car repairer	1 year	3 months	Lungs	Yes.	Not known	No	No	Yes	No
111	M	23	Laborer	1 year	4 months	Lungs	No.	Hereditary	Yes, brother	Treated in hosp'l	No	Yes
112	M	60	Physician	15 years		Lungs	Yes.	Not known	No	No	Yes	Yes
113	M	19	Farm hand	8 months	2 months	Lungs	Yes.	Not known	No	No	Instruc'd.	No
114	F	29	Housewife	4 months	10 days	Lungs	Yes.	Relative in Buffalo, N.Y.	No	City hospital	No	
115	M	45	Lawyer	2 years	1 month	Lungs	Yes.	Not known	No	Treated in city hospital	Yes	
116	M	24	Factory hand	4 years	6 months	Lungs		Not known	Not known	Don't know	No	
117	M	42	Laborer	2 years +		Lungs	Yes.	Wife and childr'n	Yes, wife. 2 chil.	Yes	No	Yes
118	F	35	Housewife	1 year	4½ months.	Lungs	No.		No	No	No	No
119	F	....	Child	3 weeks	3 weeks	Stomach	No.	Not known	No	No	No	No
120	F	37	Housewife			Lungs	No.	Not known	No	No	No	Yes
121	F	35	Milliner	2 years	10 weeks	Lungs	Yes.	Not known	No	No	Yes, sput.	Yes
122	M	29	Oiler	3 years	1 year	Lungs	Yes.	Sister	Yes	No	Yes	Yes
123	M	44	Laborer	3 years	6 months	Lungs	No.	Hereditary	Yes	Not known	Yes	Yes
124	F	5	Infant	3 weeks	3 weeks	Meninges	No.	Hereditary	Yes, in father's family.	No	No	No
125	F	33	H'sewife, form. tchr.	3 years	3 months	Lungs	No.	Not known	No	No	Yes	Yes
126	F	36	Housewife	2½ years	4 months	Lungs	Yes.	Not known	Yes, cousin	No	Yes	Yes
127	F	27	Housewife	3 years	6 months	Lungs	Yes.	Hereditary	Yes	No	?	Yes
128	F	20	Housewife	6 months		Lungs	No.	Fast life, etc	No	No	?	No
129	M	21	Laborer	10 months	6 months	Lungs	No.	Not known	Yes, mother died.	Not known	Yes	No
130	F	52	Housewife	3 years	10 days	Lungs	Yes.	Not known	No	No	Partially.	No

131	F	48	Housewife	10 years +	3 months	Lungs	No.	Not known	Not known	No.	Partially.	Yes.
132	M	31	Retired		2 weeks	Lungs	Yes.	Not known	No.	No.	Yes.	Yes.
133	M	28	Janitor	6 months	1 month	Lungs	Yes.	Pneu. 6 years ago?	Yes, one sister	Not as far as k'n.	Yes.	No.
134	M	17	Jeweler's appr.	1 year	5 months	Lungs	Yes.	Hereditary tend.	Yes.	Yes.	Yes.	Yes.
135	M	19	Packing clerk	3 years	1 month	Lungs	Yes.	Hereditary	Yes, father and mother.	Don't know	Yes.	Yes.
136	M	43	Tailor	1 year	2 weeks	Lungs	Yes.	Not known	No.	No.	Yes.	Yes.
137	M	48	Liquor dealer	3 years	3 months	Lungs	No.	Not known	No.	No.	Yes.	Yes.
138	M	21	R. R. clerk	Sev. years	1 year	Lungs	Yes.	Not known	No.	Not known	Yes.	Not kn'n.
139	F	29	Housewife	2 years	2 years	Lungs	No.	Not known	St. Peter hospital		Yes.	
140	M	3	Infant	Life	Life		No.	Mother.	Mother.		Yes.	
141	M	40	None	1 year	3 months	Lungs	No.	?	?	County hospital.	Yes.	No.
142	M	1	Infant	3 months	6 weeks	Meninges	No.	Visiting tub. pat.	Grandfather and uncle.	One in flat above	No.	No.
143	F	38	Housewife	3 years	1 year	Lungs	No.	Not known	No.	Don't know	Yes.	?
144	F	30	None	18 months	3 months	Lungs	No.	Not known	No.	No.	No.	Yes.
145	F	38	Stenographer	Sev. years	3 months	Lungs	Yes.	Not known	?	Sick at city hosp.	Yes.	
146	F	41	Housewife	6 months	4 months	Lungs	No.	Not known	No.	?	Yes, sput.	No.
147	M	31	Printer	2 years	2 months	Lungs	No.	Not known	Yes, father	No.	Yes.	No.
148	M	15	School boy	1 year	4 months	Lungs	No.	Not known	No.	?	No.	?
149	M	1mo.	Infant	10 days		Meninges	No.	Not known	Yes.	Not known		No.
150	F	33	Housewife	7 months	7 months	Lungs	Yes.	Old house	Yes.	Don't know	Yes.	Don't know.
151	M	44	Oiler car shops	2 years	6 months	Lungs	No.	Home	Yes, son and wife	No.	Yes.	Yes.
152	F	13	School girl	2 years	3 months	Lungs & bones of foot	No.	Not known	No.	No.	Yes.	No.
153	M	18	Framemaker	8 months	1 month	Lungs	Yes.	Not known	Mat. aunt, pat. uncle.	No.	Yes.	Yes.
154	M	57	Farmer	2 years	6 months	Lungs	No.	Not known	No.	?	No.	?
155	F	63	Housewife	Many years	1 month	Intestines	No.	Heredity	Yes.	No.	Yes.	Yes.
156	F	23	Teacher	14 months	10 months	Peritoneum	No.	Not known	No.	No.	Yes.	No.
157	M	7	School boy	8 weeks	6 weeks	Meninges	Yes.	Not known	No.		Yes.	
158	M	11	School boy	7 months	7 months	Hip joint	Yes.		Yes.	Yes.	Yes.	Yes.
159	M	17	None	Never well.	3 months	Lymphatics, lungs	No.	Not known	?	?	No.	?
160	F		Housewife			Lungs	No.				No.	
161	M	53	Dining car con.	2 years	6 weeks	Lungs	No.	Hereditary	Yes, mother	No.	Yes.	Yes.
162	F	24	Housewife	8 months	2 months	Lungs	Yes.	Sister	Yes.	?	Yes.	?
163	F	7mo.	Infant	3 months		Brain and lungs.	No.	Not known	No.	No	No.	No.
164	M	30	Laborer	2 years	6 weeks	Lungs	Yes.	Not known	No.	Not known	Yes.	Yes.
165	F	19mo	Infant	2 weeks		Lungs, meninges	No.	Foll'd measles	Not known	No.	No.	No.
166	M	60	Farmer	Sev. years	1 week	Lungs	No.		Yes.		No.	No.
167	F	17	School girl	4 years	4 months	Lungs	Yes.		No.	No.	Yes?	Yes.
168	M	38	Music director.	10 years	1 year	Lungs	Yes.	Brother	Brother	Not known	No.	Yes.
169	F	42	Housewife	Few m'nths	Few m'nths	Lungs	No.	Not known	No.	No.	No.	Yes.
170	F	37	Housewife.	2 years	6 months	Larynx, lungs	Yes.	Not known	No.	No.	Partial	No.
171	M	26		2 years	3 months	Lungs	No.	Sister	Yes, sister	Yes.	Partial	No.
172	M	32	Cook	1 year	1 year	Lungs	No.	Not known	No.	Hospital	Yes.	Yes.
173	M	41	Teamster	2 years	3 months	Lungs		Foll'd la grippe ?.	No.	No.	No.	Yes.
174	F	32		Sev. years	Sev. years.	Lungs	No.	Not known		Hospital case	Yes, sput.	
175	M	28	Lumber jack		3 months	Lungs	No.	Mother	Yes, mother	Sisters' hospital.	Yes.	Yes.
176	F	5	Infant		3 months	Peritoneum, meninges.	No.	Not known	No.	No.	Yes.	Yes.
177	F	16	School girl	9 months	2 months	Knee, lungs	No.	Had tub. dis. knee 7 yrs	No.		Yes.	
178	F	73	Housewife	Many years	4 months	Lungs	No.	Not known	Not known	No.	No.	No.
179	F	53	None	6 months?	2 months	Lungs	Yes.	Son-in-law	Son-in-law	Son-in-law	Yes.	No.
180	M	53	Cook	Not known.		Lungs	Yes.	Not known	Not known		Yes.	
181	F	37	Housewife.	1 year	3 months	Lungs	Yes.	Not known	No.	No.	Yes.	No.
182	F	69	Housewife.		3 months	Intestines		Not known	No.	No.	Yes.	No.

TABLE V.—Continued.

Case.	Sex.	Age.	Occupation.	Duration.	Confined to House.	Parts Involved.	Bact. Ex.	Source of Infection.	Previous Cases in Family.	Previous Cases in House	Sputum or Excreta Disin-fected.	Room Disin-fected after Death.
183	F	17	School girl	4 years	3 months	Lungs	No	Not known	Mother, yes	No	Yes	No
184	F	35	Housewife	Years	months	Lungs	Yes	Family	Yes, fath. & bro.	Yes	Yes	Yes
185	F	28		11 years	6 months	Lungs	Yes	Sister	Yes, sis. 11 yrs. ago	Yes	Yes	Yes
186	M	58	Laborer	20 years	2 months	Lungs	No	Not known	Yes, daughter	No	Yes	No
187	M	23	Laborer	5 years	2 months	Lungs	Yes	Not known	Yes, sister	No	Yes	No
188	F	21	Housewife	2 years	1 month	Lungs	No	Not known	No	No	Yes	No
189	M	74	None	20 years	1 month	Lungs	No		Yes	No	Yes	Yes
190	F	24	Housewife	2 months	3 weeks	Lungs	No		Yes	Not known		
191	M	24	Mechanic	1 year	3 months	Cervical glands, lungs	No	Not known	Not known	No	No	No
192	M	1 mo.	Infant	Life	Life	General	No	Mother	Yes, mother		No	
193	M	57	Farmer	1½ years	4 months	Lungs	No	Not known	No	No	No	Yes
194	M	45	Miller	2 years	2 months	Lungs	Yes		Yes, moth. & bro.	No	Yes	Yes
195	M	45	Laborer	3 weeks	3 weeks	Lungs		Not known	Not so far as k'n.	Yes	Yes	Yes
196	F	41		10 months	2 months	Lungs	No	Not known	No	No	Yes	Yes
197	M	22	Farmer	19 days	11 days	Meninges	No	Not known	No	No		No
198	F	22	Housekeeper	Sev. years	2 months	Lungs	Yes	Not known	Yes	Yes	Yes	Yes
199	F	53	Housewife	9 months	2½ months	Lungs	No	Not known	Yes, brother	No	Yes	Yes
200	M	34	Farmer	2 years	2 days	Lungs	No	Not known	No	No	No	Yes
201	F	21	Housemaid		3 weeks	Lungs	No	Measles	No	No	No	
202	M	5	Farmer's son	6 weeks	3 weeks	Meninges	No	Not known	Yes, grandfather	No	No	No
203	F	11	School boy	2 years	3 months	Lungs	No	Mother	Yes, mother	?	No	No
204	F	51	Housewife	2 years +	4 months	Lungs	Yes	Husband	Yes	Yes	Yes	Yes
205	M	49	Farmer	7 years	12 days	Lungs	No	Family	Yes, daughter & others.	No	No	No
206	F	3½	Child	8 days	8 days	Lungs	No	Not known	Yes, child same family.	Don't know	Yes	Yes
207	M	50	Farmer	2 years	3 months	Lungs	Yes	Not known	No	No	Yes	No
208	F	28	Domestic	9 months	4 months	Lungs	No	Not known	Yes	Yes	Yes	No
209	F	28	None	9 months		Lungs	No	Not known	Yes, brother	Yes, 1 or 2	Yes	No
210	M	74	Farmer	6 months	1 month	Lungs	No	Not known	No	No	Yes, sput.	No
211	F	38	None	2 years	4 months	Lungs	No	Not known	Mat aunts, uncles & mo.?	Yes	Yes	Yes
212	F	42	Farmer's wife	3 years	2 years	Lungs	Yes	Not known	No	No	Yes	No
213	F	20	Housework	8 months	3 months	Lungs	Yes	Tuberc. fam. his.	Yes, mother	Yes, mother	No	Yes
214	F	56	Housewife	4 years	8 months	Lungs	No	Not known	No	Not known	No	Not kn'n.
215	F	22	Housewife	16 months	6 months	Lungs	No	Not known	Yes, one cousin	No	Yes	Yes
216	F	24	Housemaid	4 years	4 months	Lungs	No	Not known	No	Yes, 1	Yes	No
217	M	25	Farmer	3 years	3 months	Lungs	No	Not known	No	No	No	No
218	F	22	Teacher	6 months +	4 months +	Lungs	No	Sister?	Yes, sister?	Yes	Partially	Partially
219	F	67	Housewife	18 months	1 years	Lungs	Yes	Grandson?	Grandson, 1900	No	Yes	Yes
220	F	11	Domestic	4 years	8 months	Lungs		Not known	No	No	Yes	Yes
221	M	44	Janitor	1 year	2 months	Lungs	Yes	Not known	No	Not known	Yes	No
222	F	43						Not known				

223	M	33	Laborer	18 months	10 months	Lungs, bowels	No	Not known	No	Not known	No	No
224	F	18	None	10 months	5 months	Hip joint, lungs.	No	Not known	No	No	Yes	No
225	M	45	Laborer	5 years	3 months	Pleura, lungs	Yes.	Not known	No	No	Yes	No
226	....	8 mo	Infant	8 months	8 months	Lungs	No	Inheritance	Yes	Yes	Partially	No
227	M	30	Carpenter	2 years	2 months	Lumbar vertebra, lungs	Yes.	Injury to spine	No	......	Yes	......
228	F	33	Housewife	3 years	4 weeks	Lungs	No.	Not known	No	No	No	Yes
229	M	31	Fireman	3 years	2 months	Lungs	Yes.	Not known	Probably	Not known	Yes	Yes
230	M	39	Expressman	3 months	3 months	Lungs	Yes.	Not known	Not as known	City hospital	Yes	......
231	M	48	Laborer	3 months	3 months	Peritoneum	No	Not known	No	No	No	No
232	M	53	Laborer	6½ months.	4 months	Lungs	Yes.	Not known	Not known	City hospital	Yes	......
233	M	38	Plumber	5 months	4 months	Lungs	Yes.	Not known	No	City hospital	Yes	......
234	M	45	Laundryman	2½ years	5 months	Lungs	Yes.	Hereditary	Yes, father	No	Yes	Yes
235	M	63	Laborer	4 years	1 month	Lungs	Yes.	Nephew?	Yes, nephew	Yes	Yes	?
236	M	32	......	1 year	......	......	......	Not known	Not known	......	Yes	......
237	M	16	School boy	1 year	2 months	Larynx	No	Brother	Yes, brother	Yes	No	No
238	M	25	Laborer	6 months	1 week	Cerv. glands, lungs	Yes.	Not known	No	In St. Jos'h's Hos	Yes	......
239	F	24	Housewife	2 years	3 months	Cerv. glands, lungs	Yes.	Not known	No	No	Yes	Yes
240	F	2	Infant	1 week	1 week	Meninges	No	Not known	Yes, moth.'s bro.	No	......	No
241	F	25	Housewife	15 months	2 months	Lungs	Yes.	Mother?	Yes, mother	No.	Yes	Yes
242	M	50	Laborer	3 years	1 year	Lungs	Yes.	Not known	No	Not known	Yes	......
243	F	49	Housewife	7 years	3 months	Lungs	Yes.	Not known	Yes	......	Yes	......
244	F	20	Factory girl	9 months	3 months	Lungs	Yes.	Not known	No	No	Yes	Yes
245	F	22	Clerk	7 months	3 months	Lungs	......	Not known	No	No	......	No
246	F	31	Housekeeper	1 year	3 months	Lungs	Yes.	Not known	No	Not known	?	No
247	M	60	Farmer	1 year	2 months	Lungs	Yes.	......	Yes	No	Yes	No
248	M	63	Farmer	......	6 weeks	Lungs	Yes.	......	......	......	Yes	......
249	F	49	Housekeeper	9 years	2 months	Lungs	Yes.	Brother	Yes, bro. 9 yrs ago	No	Yes, sput.	Yes
250	M	51	Stone cutter	1 year?	3 months	Stomach, lungs	Yes.	Not known	No	No	Yes	No
251	M	61	Laborer	......	8 weeks	Lungs	No	Not known	No	In hospital	......	......
252	M	37	Merchant	1 year	2 months	Lungs	Yes.	Hereditary	Yes	No	Yes	Yes
253	M	77	Capitalist	4 years	3 months	Lungs	......	Fol'd pneumonia	No	No	Yes	Yes
254	F	36	Housewife	4 years,	3 months	Lungs	No	Not known	Yes	No	Yes	?
255	M	40	Laborer	......	1 month	Intestines	No	......	......	......	No	......
256	M	23	Laborer	3 years	3 months	Lungs	......	?	Yes	No	......	Yes
257	F	14	Student	1 year	1 month	Lungs	No	Not known	Yes, moth.'s moth	No	Yes	No
258	M	29	Telegraph opr.	3 years	1 month	Larynx	Yes.	Family	Yes	No	Yes	No
259	F	49	Housewife	16 months	5 months	Lungs	No	......	Yes, son & d't'r	Yes	No	Yes
260	F	60	Housewife	12 years	3 months	Lungs	No	Not known	No	No	Yes	No
261	M	16	Farmer	......	4 days	Pul. hem.	No	Not known	No	No	No	No
262	M	8	Farmer's boy	Years	1 week	Meninges	No	Not known	Yes	No	......	Yes
263	F	32	Housewife	2 years	4 months	Lungs	Yes.	Not known	No	No	Yes	Yes?
264	F	21	Housewife	2 years	......	Lungs	No	Not known	No	No	Yes	No
265	M	1	Infant	2 months	2 months	......	No	Not known	Yes, 1 sis. of f'r, 2 of mo.	No	No	No
266	M	21	Farmer	14 months	3 months	Lungs	Yes.	At poorhouse	Yes	Yes	Yes	Yes
267	M	39	Lumbering	3 years	18 months	Lungs	Yes.	Foll'd la grippe	No	No	......	No
268	F	21	Housew'k (home)	......	3 weeks	Meninges	No	Foll'd la grippe	No	No	No	No
269	F	20	Teacher	6 months	2 weeks	Larynx	No	Not known	No	No	Yes	No
270	M	27	Farmer	......	2 months	Lungs	No	Family	Yes	No	Yes	Yes
271	M	26	Clerk	4 months	2 months	Lungs	Yes.	......	......	Not known	Yes	No
272	M	23	Clerk in P. O	5 years	......	Lungs	Yes.	Not known	No	......	......	......
273	M	29	Farmer	1 year	6 months	Meninges, lungs.	No	Not known	No	No	No	No
274	F	28	Housewife	2 years	3 months	Lungs	Yes.	Hereditary	Yes	Yes	Yes	Yes

TABLE V.—Continued.

Case.	Sex.	Age.	Occupation.	Duration.	Confined to House.	Parts Involved.	Bact. Ex.	Source of Infection.	Previous Cases in Family.	Previous Cases in House.	Sputum or Excreta Disinfected.	Room Disinfected after Death.
275	F	12	Child	4 months	10 days	Hip joint, meninges	No		No	No	No	No
276	F	47	Housewife	2 years	1 month	Lungs	No	Not known	No	No	Yes	Yes
277	F	49	Housekeeper	10 months	3 months	Lungs	Yes	Foll'd la grippe	No	Don't know	Yes	Yes
278	F	6	Child	2 weeks	2 weeks	Meninges	No	Mother	Yes, mother [living]	Yes, mother	No	No
279	M	20	Student	1 year	1 month	Intestines	No	Not known	No	No	No	Yes
280	M	5	Child	5 weeks	3 weeks	Intestines	No	Mother	Yes, mother	Yes, mother	No	No
281	M	21	Saw-mill oiler	18 months	2 months	Lungs	Yes		No	No	Yes	Yes
282	M	3	Child	14 days	14 days	Meninges	No	Mother (living)	Yes, mother	Yes		Yes
283	M	74	None	3 months	2 weeks	Lungs	Yes	Not known	No	No	No	No
284	M	23	Farmer	2 years	3 months	Lungs	No		Yes, 14 yrs. ago	No	No	No
285	F	47	Housekeeper	3 years	2 weeks	Lungs	No	Family?	Yes	Yes	Yes	Yes
286	F	4 mo	Child		1 month	Skin, intestines		Not known	No	No	Yes	Yes
287	M	28	Dentist	?	1 month	Lungs		Wife	Yes, wife	Pat. died in hospital	Yes	
288	M	5	Child			Glands of neck						
289	M	47	Miner	Sev. months	4 months	Lungs	No		No	Red Cross Hosp'l	Yes	
290	M	50	Tailor	2 years	9 months	Intestines	No	In army	No	Not so far as k'n	Yes	Yes
291	F	10	School girl		3 weeks	Meninges	No	Not known	Yes, brother, hip joint	Yes, brother		Don't k'w
292	F	22	Domestic	1 year	2 months	Lungs	No	Not known	No	No	No	No
293	F	30	None	8 years	2 weeks	Lungs	Yes	Not known	No	Don't know	No	No
294	M	51	Bookkeeper		10 days	Hemorrhage	No	Not known	Yes	Not known	No	No
295	F	44	Housekeeper	5 years	3 months	Peritoneum	Yes	Not known	No	Not known	Yes	No
296	F	31	Stenographer	2 years	5 weeks	Lungs	Yes	Not known	Yes, mother's sister	Yes, one	Yes	Yes
297	M	23	Farmer	1 year	1 month	Lungs	Yes	?	No		Yes	
298	F	6	Child	2 years	1 month	Glands neck, lungs	Yes	Not known	Yes, mother	Yes	Yes	No
299	M	56	Painter	15 months	4½ months	Lungs	Yes	La grippe	Yes, 2 sons	No	Yes	Yes
300	F	18	School girl	1 year	8 months	Lungs	No	Not known	No	No	No	Yes
301	M	50	Tailor	1 year	Few days	Lungs	Yes	Wife, 3 years ago	Yes, wife	Yes, wife	Yes	No
302	F	36	Domestic	2 years	3 months	Lungs	Yes	Not known	Not known	No	Yes	No
303	M	39	Druggist	2 years	3 weeks	Lungs	Yes	?	Yes, sister	No	Yes	Yes
304	F	50	Housewife	20 years	4 months	Lungs	Yes	Not known	No	No	Yes	No
305	F	16	School girl	10 months	4 months	Lungs	Yes	Heredity	Yes, aunt	Not known	Yes	No
306	M	39	Coal merchant	10 months	2 months	Larynx, lungs	Yes	Not known	No	No	Yes	No
307	F	42	Housewife	2 years	6 months	Lungs	No	Not known	No	No	Yes	?
308	F	45	None	10 years		Lungs	No	Not known	No	No	No	Yes
309	F	21	Rag sorter	10 months	3 months	Lungs		Rags		No	Yes	No
310	M	42	Laborer	1 year	2 months	Lungs	Yes	Not known	Yes, moth., 2 sis., 3 bro	City hospital	Yes	
311	F	35	Housewife	1 year	3 months	Lungs			Yes	Don't know	Partially	No
312	F	32	Housewife	4 years	10 months	Lungs	Yes	Not known	No	Yes	Yes	Yes
313	F	30	Housewife	2 years	4 months	Lungs	Yes	Not known	Yes, moth., 1 sis.	City hospital	Yes	
314	M	42	Farmer			Lungs	No	Not known	Yes		No	

315	F		Housewife	3 years	5 months	Lungs		Not known	No?	No	?	Yes
316	F	49	Housewife	10 years	1 year	Tibia, lungs	No	Not known	No	No	No	No
317	F	23	None	3 years	6 months	Lungs	Yes	Hereditary	Yes, father, mat. aunts	No	Yes	Yes
318	M	42	Farmer	1 year	6 weeks	Lungs	Yes		No	No	Yes	Yes
319	F	17	Dressmaker	12 years	8 months	Hip, lungs	Yes	Hereditary	Yes, moth., 2 sisters.	Yes, sister	Yes	Yes
320	M	9	School boy	2 years	2 months	Hip & meninges	No	Father	Yes, father	Father, 10 yrs. bef	No	Yes
321	M	37	Saloon porter	2 years	3 weeks	Lungs	No	Not known	No	No	Yes	No
322	F	21	Housewife	1 year	Not at all	Lungs	Yes	Not known	No, ex. pat. grandmoth.	No	No	No
323	M	7 mo	Infant	4 weeks	4 weeks	Meninges	No	Father	Yes, father	Yes, father	No	No
324	M	18	Farmer	4 years	2 weeks	Lungs	Yes	Relatives	Yes, 2	Two	Yes	No
325	F	68	Housekeeper	8 months?	1 month	Lungs	No	Daughter	Yes, d'r. 1 y'r ago	No	Yes	Not kn'n.
326	F	68	None	4 years	6 weeks	Lungs	No	Not known	No	No	Yes	Yes
327	F	27	Housewife	9 months	3 months	Lungs	Yes	Tub. family hist.	Yes, moth. & sist'r	No	No	No
328	M	22	Elevator opr	16 months	4 months	Throat, lungs	Yes	Not known	No	No	Yes	Yes
329	F	18	Servant	1 year	2 months	Forearm, peritoneum	No	Not known	No	Hospital	Yes	
330	M	24	Miner	18 months	17 months	Bladder	No	Not known	No	Red Cross Hosp'l	Yes	
331	F	24	Housewife	9 years	4 months	Lungs	No	Not known	No	No	?	No
332	F	14	Child	12 years	6 months	Spine, lungs	No	Not Known	No	No	No	No
333	M	22	Barber	6 months	6 months	Lungs	Yes	While nursing?	Yes, mater. aunt.	Not known	Yes	
334	M	25	Druggist	1 year	2 months	Lungs	No	Not known	Yes, father when babe	No	Yes	Yes
335	F	20	In shoe factory	4 months	4 weeks	Lungs	No	Foll'd pul. hem.	Yes	?	No	?
336	F	41		4 years	6 months	Lungs	Yes	Not known			Yes	
337	F	80	Housewife	2 years	3 months	Lungs	No	Not known	Not as known	No	Yes	?
338	F	40	Housewife	1 year	2 months	Lungs	Yes	Not known	No	No	Yes	Yes
339	F	45	Housewife	8 months	3 months	Lungs	No	Son	Yes, son, 1 y'r ago	Yes, son	Yes	No
340	M	43	Laborer	4 years	2 months	Lungs	No	Not known	No	No	?	No
341	F	60	Housewife	6 months	6 weeks	Lungs	No	Not known	Yes, son, 2 1-2 y'rs ago.	Yes, son	Yes	Yes
342	F	22	Telephone opr	15 months	3 months	Lungs	Yes	Foll'd typhoid	No	No	Yes	Yes
343	F	65	Housewife	3 years	2 months	Lungs	No	Hereditary	Yes	No	Yes	?
344			Infant	3 years	6 months	Glands	No	?	No	Cared for in Swed. hosp.		
345	F	32	Housewife	1 year	6 months	Lungs	No	Not known	No	No	Yes	Yes
346	F	42	Housekeeper		2 months	Lungs	No	Not known		?	No	?
347	F	18 mo	Infant	3 weeks	2 weeks	Meninges	No	Father	Yes, father	Yes	No	No
348	M	41	Laundryman	1 year	8 months	Lungs	No	Not known	No	No	No	Yes
349	F	61	Housewife	4 weeks	4 weeks	Lungs	No	Not known	No	No	Yes	No
350	M	23	Clerk	3 months	3 months	Intestines	No	Not known	No	No	Yes	Yes
351	M	6	Infant	2 weeks	2 weeks	Meninges	No		Probably	Yes, 1 case	No	No
352	F	25	Housewife	6 months	3 months	Lungs	No	Not known	No	No	No	Yes
353	M	35	Carpenter	9 months	1 month	Testicles, lungs	No	Not known	Yes	Not known	Yes	Yes
354	F	10	School girl	2 years	2 weeks		No	Tub. hist. on mother's.	Yes	No	Yes	No
355	M	27	Clerk	1½ years	2 months	Lungs	Yes	Seq. to pneum	No	No	Yes	Yes
356	M	44	Laborer	18 months	18 months	Lungs	No	Seq. to pneum	Yes	No	Yes	Yes
357	F	28	None	5 years		Lungs	No	Not known	No	No	Yes	No
358	F	27	Housewife	2 years	6 months	Lungs	No	Not known	No	No	Yes	No
359	M	53	Captain	13½ years	3½ months	Lungs	No	Not known	Yes, sister & bro.	No		No
360	F	21	Housework	1 year	2 months	Lungs	No	Not known	No	No	Yes	Yes
361	M	57	Laborer		2 months	Lungs	No	Not known	No	Red Cross Hosp'l	Yes	Yes
362	M	38	Clerk	18 months	4 weeks	Lungs	Yes	La grippe	No	?	Yes?	?
363	F	29	Servant	2 years	6 months	Lungs, intestines	Yes	?	Yes	No	Yes	Yes
364	M	44	Tailor	Sev. years	1 year	Knee, lungs	Yes	Tub. knee	?	Bethesda Hosp'l.	Yes	
365	M	5	Child	4 weeks	3 weeks	Meninges	No	Not known	No	No	No	No
366	M	48	R. R. fr't agt	5 years	3 months	Lungs				No	Yes	Yes

TABLE VI.—Continued.

Case.	Sex.	Age.	Occupation.	Duration.	Confined to House.	Parts Involved.	Bact. Ex.	Source of Infection.	Previous Cases in Family.	Previous Cases in House.	Sputum or Excreta Disinfected.	Room Disinfected after Death.
367	M	34	Farmer	6 months	6 months	Pharynx, lungs	No	Not known	No	No	Yes	Yes
368	F	21	Teacher	....	11 weeks	Lungs	No	Sister ?	Yes. sister	No	Yes	Yes
369	F	30	Housewife	3 years	2 months	Lungs	Yes	Brother	Yes, father, 3 bro.	No	Yes	Yes
370	F	45	Housewife	1 year	no time	Lungs	No	Not known	Not known	?	No	?
371	M	10	School Boy	6 months	5 months	Intestines	No	Not known	No	No	No	No
372	F	26	Clerk	2 years	....	Lungs	No	....	No	No	No	Yes
373	F	13	School Girl	1 year	6 months	Lungs	No	Mother	Yes, mothr, died spg '01	Yes, mother	Yes	No
374	F	40	Housewife	8 years	2 weeks	Lungs	No	First husband	Yes, first husb'nd	No	Yes	No
375	M	50	With circus	2 years	4 months	Lungs	No	Not known	Not known	No	Yes	Yes
376	M	37	Merchant	4 years	1 year	Lungs	Yes	Not known	One brother	No	No	Yes
377	F	38	Farmer's wife	4 years	4 months	Lungs	Yes	....	Husband's first wife	Yes. husband's 1st wife	Yes	No
378	F	10	Student	16 months	8 months	Lungs	No	Not known	No	No	Yes	Yes
379	F	21	Domestic	4 months	4 weeks	Lungs	No	Not known	No	No	No	Yes
380	M	50	Farmer	6 years	11 months	Lungs	Yes	Not known	Yes, his sister	No	Yes	No
381	F	22	Housewife	3 years	3 months	Glnds, lngs, peritonenm	Yes	Sister ?	Yes	No	Yes	Yes
382	F	1	Infant	10 months	10 months	Spine, meninges, lungs	No	Not known	No	No	Yes	No
383	F	42	Concubine	2 years	Not at all	Lungs	No	Not known	?	No	No	Yes
384	M	34	Grocer	20 years	2 months	Lungs	No	Not known	Yes, father's bro.	No	Yes	Yes
385	F	10	School girl	8 months	3 weeks	Lungs	No	Not known	Yes	No	Yes	No
386	F	31	Farmer's wife	3 years	3 months	Peritoneum, lngs	Yes	Not known	No	No	Yes	Yes
387	F	25	Housewife	1 year	3 months	Lungs	Yes	Foll'd pregnancy	No	No	Yes	Yes
388	M	42	Farmer	3 months	1 month	Lungs and bowels	No	Not known	Not known	No	Yes	No
389	F	12	School girl	5 months	2 months	Cervical glands, lungs	Yes	Not known	No	No	Yes	Yes
390	F	39	Housewife	2 years	7 months	Hip joint, lungs	No	Not known	No	No	....	No
391	F	54	Housewife	4½ months	2 months	Lungs	Yes	Not known	No	No	Yes	No
392	M	52	Blacksmith	18 months	7 months	Rectal fissures, lungs	No	Not known	No	No	Yes	Yes
393	F	11	Child	1 year	6 months	Intestines	No	Not known	Yes	Don't know	Yes	Yes
394	M	47	Clerk	2 years	6 months	Throat, lungs	No	Not known	No	No	Yes	Yes
395	M	10mo	Infant	....	1 week	Meninges	No	Father	Yes fathr died 6-28-'00 1 sister died 10-17-'01	Yes, fathr & sistr	....	Yes
396	M	12	School boy	3 months	....	Lungs	No	Mother, died 2 yrs. ago	Yes, mother	Yes, mother	Partially	No
397	M	25	R. R. Engineer	2 years	1 month	Lungs	Yes	Inherited	Yes, fathr, 1 sistr	Yes, fathr & sistr	Yes	No
398	F	18	Student	18 months	3 months	Lungs	No	Family	Yes, 3 or 4 bros. & sistrs	Yes, 3 or 4	Yes	?
399	M	20mo	Infant	....	2 months	Lungs	No	Mother, dead	Yes, mother	Yes	Yes	Yes
400	F	32	Dept. store clk.	6 months	4 months	Lungs	Yes	Husband	Yes, husb. died 1 yr ago	Died in hospital	Yes	Yes
401	F	23	Housewife	6 months	2 months	Larynx, lungs	No	Not known	Yes	Not known	Yes, sp.	No
402	M	8	None	....	....	Hip	No	Not known	No	Died in hospital	Yes	....
403	F	21	....	8 days	8 days	Meninges	No	....	No	No	....	No
404	M	22	Cook	6 months	1 month	Lungs	Yes	Not known	No	No	Yes	No
405	M	59	Cattle dealer	18 months	2 weeks	Lungs	Yes	....	Yes	Yes, soldiers' home	Yes	Yes

406	F	62	Housewife	6 months	6 months	Lungs	Yes.	Sons ?	Yes, 2 sons	Yes, 2 sons	Yes, sp.	Yes
407	M	45	Farmer	8 months	1 month	Throat, lungs	No.	Exposure	No	Yes, in city hosp.	Yes	....
408	F	22	Cigarmaker	4 months	6 weeks	Lungs	Yes.	Dust in cigar factory	Yes, on father's side	No	Yes	No
409	M	29	Fireman	7 months	3 months	Lungs	No.	Fiancé	No	No	Yes	Yes
410	F	28	Sewing girl	1 year	5 months	Lungs	No.	Mother	Yes, mother	Yes, in hospital	Yes	....
411	F	49	Housewife	18 months	3 months	Larynx, lungs	Yes.	Not known	Yes	Not so far as known	Yes	....
412	M	33	Barber	3 years	3 weeks	Lungs	Yes.	....	Yes, fathr, 1 bro, 1 sister	....	?	No
413	M	35	Meat dealer	4 months	4 months	Intestines	Yes.	....	No	Was in hospital	Yes	....
414	M	27	Laborer	3 months	2 weeks	Lungs	Yes.	....	No	In city hospital	Yes	....
415	M	25	Farmer	4 years	2 weeks	Pleura, lungs	Yes.	Not known	No	No	Yes	Yes
416	F	44	Housekeeper	18 months	3 weeks	Lungs	No.	Not known	No	Don't know	No	Yes
417	M	24	Laborer	2 years	4 months	Lungs	No.	Not known	No	No	No	No
418	M	40	Grocer	1 year	3 months	Lungs	Yes.	Not known	No	No	Yes, sp.	No
419	F	36	Housewife	3 years	2 months	Lungs	Yes.	Mother	Yes, mother	No	Yes	Yes
420	F	17	School girl	1 year	2 months	Lungs	?	Not known	No	No	Yes	No

For further statistics on tuberculosis see Tables I., II., III. and IV.

TABLE VI.

Deaths from Tuberculosis Given in Decades.

1 TO 10 YEARS.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
13		M	1 month		Intestines	?
16	1	M	4 weeks	4 weeks	Lungs	?
19	5 mos.	M	5 months	5 months	Intestines	Mother.
23	3	M	3 weeks	3 weeks	Cervical glands	Milk ?
24	13 mos	F	6 months		Lungs	?
33	3 mos.	F	3 months	3 months	Cervical glands	Father.
65	2	M	6 weeks	10 days	Meninges	Grandmother.
140	3	M	Life	Life		Mother.
142	1	M	3 months	6 weeks	Meninges	Visitors.
149	1 mo.	M	10 days		Meninges	?
163	7 mos.	F	3 months		Meninges & Lungs	?
165	19 mos	F	2 weeks		Meninges & Lungs	Following measles.
192	1 mo.	M	Life	Life	General	Mother.
206	3½	F	8 days	8 days	Lungs	?
240	2	F	1 week	1 week	Meninges	Mother & brother.
265	1	M	2 months	2 months		1 Paternal aunt, 2 m'tern'l aunts
282	3	M	14 days	14 days	Meninges	Mother.
286	4 mos.	F		1 month	Skin & Intestines	?
324	7 mos.	M	4 weeks	4 weeks	Meninges	Father.
348	18 mos	F	3 weeks	2 weeks	Meninges	Father.
383	1	F	10 months	10 months	Meninges & Lungs	?
396	10 mos	M		1 week	Meninges	Father.
400	20 mos	M		2 months	Lungs	Mother.
31	6	M	4 weeks	18 days	Meninges	Cousin.
124	5	F	3 weeks	3 weeks	Meninges	Heredity.
157	7	M	8 weeks	6 weeks	Meninges	?
176	5	F		3 months	Peritoneum, Meninges	?
202	5	M	6 weeks	3 weeks	Meninges	?
262	8	M	Years	1 week	Meninges	?
278	6	F	2 weeks	2 weeks	Meninges	Mother.
280	5	M	5 weeks	3 weeks	Intestines	Mother.
288	5	M			Cervical glands	?
291	10	F		3 weeks	Meninges & Lungs	Brother.
298	6	F	2 years	1 month	Cervical Glands	Mother.
320	9	M	2 years	2 months	Hip & Meninges	Father.
351	6	M	2 weeks	2 weeks	Meninges	?
354	10	F	2 years	2 weeks	Lungs	Family.
365	5	M	4 weeks	3 weeks	Meninges	?
371	10	M	6 months	5 month	Intestines	?
378	10	F	16 months	8 months	Lungs	?
385	10	F	8 months	3 months	Lungs	Family.
402	8	M			Hip.	?

Females .... 17=40.5%.
Males .... 25=59.5%.

Total 42

11 TO 20 YEARS.

7	17	F	6 months	6 weeks	Lungs	Heredity.
10	18	F	1 year	1 month	Lungs	?
34	19	F	1 year	6 months	Intestines	?
36	13	F	1 year	3 months	Lungs	?
38	18	F	18 months	1 month		?
39	13	M	6 months	2 weeks	Lungs	?
42	20	M	2 years	1 month	Lungs	?
45	20	F	1 year	8 months	Lungs	?
47	13	F	1 month	1 month	Lungs	Followed diphtheria.
50	15	M		12 days	Abdominal glands	?
55	19	F	3 months	13 days	Lungs	School Feeble Minded.
57	19	M		1 month	Lungs	?
64	17	F	6 months	3 months	Lungs	?
74	14	M	6 months	2 months	Lungs.	?
76	20	M	3 months	1 month	Cervical glands	Family.

TABLE VI.—Continued.

11 TO 20 YEARS.—Continued.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
77	19	F	11 months	8 months	Lungs	3 in father's family.
85	18	F	1 year	4 months	Lungs	?
89	19	M	1 year	2 months	Pleura, lungs	Aunt.
90	18	F	1 year+	3 weeks	Stomach	Family.
93	17	F	14 weeks	8 weeks	Lungs	Father's sisters.
108	17	F	6 months	3 weeks	Lungs	Family.
109	20	F	1 year	3 months	Lungs	Brother.
113	19	M	8 months	2 months	Lungs	?
128	20	F	6 months		Lungs	?
134	17	M	1 year	5 months	Lungs	Heredity.
135	19	M	3 years	1 month	Lungs	Heredity.
148	15	M	1 year	4 months	Lungs	?
152	13	F	2 years	3 months	Tarsal bones, lungs	?
153	18	M	8 months	1 month	Lungs	Aunts and uncles.
158	11	M	7 months	7 months	Hip joint	
159	17	M	Life	3 months	Lymphatics	?
167	17	F	4 years	4 months	Lungs	?
177	16	F	7 years	2 months	Knee joint and lungs	?
183	17	F	4 years	3 months	Lungs	?
203	11	F	2 years	3 months	Lungs	Mother.
213	20	F	8 months	3 months	Lungs	Family.
220	11	F	4 years	8 months	Lungs	?
224	18	F	10 months	5 months	Hip joint and lungs	?
237	16	M	1 year	2 months	Larynx	Brother.
244	20	F	9 months	3 months	Lungs	?
257	14	F	1 year	1 month	Lungs	Mother's mother.
261	16	M		4 days	Pul. hem	?
269	20	F	6 months	2 weeks	Larynx	?
275	12	F	4 months	10 days	Hip joint & meninges	
279	20	M	1 year	1 month	Intestines	?
300	18	F	1 year	8 months	Lungs	?
305	16	F	10 months	4 months	Lungs	Heredity.
319	17	F	12 years	8 months	Hip and lungs	Heredity.
324	18	M	4 years	2 weeks	Lungs	Family.
329	18	F	1 year	2 months	Forearm, periton'um	?
333	14	F	12 years	6 months	Pott's disease, lungs.	?
335	20	F	4 months	4 weeks	Lungs	Family.
373	13	F	1 year	6 months	Lungs	Mother.
389	12	F	5 months	2 months	Cervical glands and lungs	?
393	11	F	1 year	6 months	Intestines	Family.
396	12	M	3 months		Lungs	Mother.
398	18	F	18 months	3 months	Lungs	Family.
420	17	F	1 year	2 months	Lungs	?

Females .... 39 = 67 + %.
Males .... 19=33—%.

Total 58

21 to 30 YEARS.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
1	27	F	6 months	5 weeks	Lungs	Heredity.
9	29	F	9 months	1 month	Lungs	Mother.
14	26	F	1 year	6 months	Lungs	?
17	26	M	2 years	6 weeks	Lungs	After typhoid.
18	26	F	18 months	6 weeks	Lungs	Brother now ill.
28	24	M	?	6 months	Lungs	?
40	27	M	1 year	1 week	Lungs	?
46	21	M	Sev'l mo's	1 month	Lungs	?
47	25	M	1 year	3 months	Lungs	?
32	30	M	?	?	Lungs	?
49	30	F	2 years	2 months	Intestines	?
51	28	M	3 years		Lungs	?
56	22	F	18 months	3 weeks	Lungs	?
58	22	F	10 months	4 months	Lungs	?
59	30	M	4 years	6 months	Lungs	Family?
63	28	M	18 months	None	Lungs	Family.
67	21	F	1 year	2 months	Lungs	Sister.
73	26	M	2½ years	10 days	Lungs	?

TABLE VI.—Continued.

21 TO 30 YEARS.—Continued.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
78...	27.....	F...	2 years+...	2 months...	Lungs................	?
79...	25.....	M...	3 years.....	3 months...	Lungs................	?
82...	27.....	M...	3 years.....	Few wks...	Lungs................	Father and brother.
83...	28.....	F...	8 months...	2 months...	Lungs................	Mother and brother.
84...	30.....	M...	3 years.....	6 weeks.....	Lungs................	Parents—2 bros., 2 sists.
88...	27.....	F...	5 years.....	18 months..	Bladder and Lungs..	?
92...	28.....	F...	14 months..	4 months...	Lungs................	Sisters.
95...	22.....	F...	8 months...	1 month....	Lungs................	Family.
102...	25.....	M...	1 year......	2 months...	Throat	Aunt.
105...	22.....	F...	2 years.....	6 months...	Lungs................	Heredity.
107...	26.....	M...	4 weeks	....	Testicle	?
111...	23.....	M...	1 year......	4 months...	Lungs................	Heredity.
114...	29.....	F...	4 months...	10 days.....	Lungs................	Relatives.
116...	24.....	M...	4 years.....	6 months...	Lungs................	?
122...	29.....	M...	3 years.....	1 year......	Lungs................	Sister.
127...	27.....	F...	3 years.....	6 months...	Lungs................	Heredity.
129..	21.....	M...	10 months..	6 months...	Lungs................	?
133...	28.....	M...	6 months...	1 month	Lungs................	?
138...	21.....	M...	Years.......	1 year......	Lungs................	?
139...	29.....	F...	2 years.....	2 years.....	Lungs................	?
144...	30.....	F...	18 months..	3 months...	Lungs................	?
156...	23.....	F...	14 months..	10 months..	Peritoneum	?
162...	24.....	F...	8 months...	2 months...	Lungs................	?
164...	30.....	M...	2 years.....	6 weeks.....	Lungs................	?
171..	26.....	M...	2 years.....	3 months...	Lungs................	Sister.
175...	28.....	M...	....	3 months...	Lungs................	Mother.
185...	28.....	F...	11 years....	6 months...	Lungs................	Sister.
187...	23.....	M...	5 years.....	2 months...	Lungs................	Sister.
188..	21.....	F...	2 years.....	1 month....	Lungs................	?
190...	24.....	F...	2 months...	3 weeks.....	Lungs................	Family.
191...	24.....	M...	1 year......	3 months...	Cervical gds. & lungs	?
197...	22.....	M...	19 days.....	11 days.....	Meninges	?
198...	22.....	F...	Years.......	2 months..	Lungs................	Family.
201...	21.....	F...	....	3 weeks.....	Lungs................	Following measles.
208...	28.....	F...	9 months...	4 months...	Lungs................	Family.
209...	28.....	F...	9 months...	....	Lungs................	Brother.
215...	22.....	F...	16 months..	6 months...	Lungs................	?
216...	24.....	F...	4 years.....	4 months...	Lungs................	?
217...	25.....	M...	3 years.....	3 months...	Lungs................	?
218...	22.....	F...	6 months +.	4 months...	Lungs................	Sister.
227...	30.....	M...	2 years.....	2 months...	Spine & lungs........	Began with inj'ry to spine
238...	25.....	M...	6 months...	1 week.....	Cervical gds. & lungs	?
239...	24.....	F...	2 years.....	3 months...	Cervical gds. & lungs	?
241...	25.....	F...	15 months..	2 months...	Lungs................	Mother.
245...	22.....	F...	7 months...	3 months...	Lungs................	?
256...	23.....	M...	3 years.....	3 months...	Lungs................	Family.
258...	29.....	M...	3 years.....	1 month....	Larynx and Lungs..	Family.
263...	30.....	F...	2 years.....	4 months...	Lungs................	?
264...	21.....	F...	2 years.....	....	Lungs................	?
266...	21.....	M...	14 months..	3 months...	Lungs................	Brother.
268...	21.....	F...	....	3 weeks.....	Meninges.	Following la grippe.
270...	27.....	M...	....	2 months...	Lungs................	Family.
271...	26.....	M...	4 months..	2 months...	Lungs................	?
272...	23.....	M...	5 years.....	....	Lungs................	?
273...	29.....	M...	1 year......	6 months...	Meninges and Lungs.	?
274...	28.....	F...	2 years.....	3 months...	Lungs................	Heredity.
281...	21.....	M...	18 months .	2 months..	Lungs................	?
284...	23.....	M...	2 years.....	3 months...	Lungs................	?
287...	28.....	M...	....	1 month....	Lungs................	Wife.
292...	22.....	F...	1 year......	2 months...	Lungs................	?
293...	30.....	F...	8 years.....	2 weeks.....	Lungs................	?
297...	23.....	M...	1 year......	1 month....	Lungs................	?
300...	21.....	F...	10 months..	3 months...	Lungs................	Rags.
313...	30.....	F...	2 years.....	4 months...	Lungs................	Mother and sister.
317...	23.....	F...	3 years.....	6 months...	Lungs................	Heredity.
322...	21.....	F...	1 year......	....	Lungs................	?
327...	27.....	F...	9 months...	3 months...	Lungs................	Family.
328...	22.....	M...	16 months..	4 months...	Throat and Lungs...	?
330...	24.....	M...	18 months..	17 months..	Bladder	?
331...	24.....	F...	9 years.....	4 months...	Lungs................	?
333...	22.....	M...	6 months...	6 months...	Lungs................	Aunt.
334...	25.....	M...	1 year......	2 months...	Lungs................	Family.

TABLE VI.—Continued.

21 TO 30 YEARS.—Continued.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
342...	22.....	F...	15 months..	3 months...	Lungs................	Following typhoid.
350...	23.....	M...	3 months...	3 months...	Intestines............	?
352...	25.....	F...	6 months...	3 months...	Lungs................	?
355...	27.....	M...	18 months..	2 months...	Lungs................	Following pneumonia.
357...	28.....	F...	5 years.....	....	Lungs................	?
358...	27.....	F...	2 years.....	6 months...	Lungs................	?
360...	21.....	F...	1 year......	2 months...	Lungs................	?
363...	29.....	F...	2 years.....	6 months...	Lungs and intestines	?
368...	21.....	F...	....	3 months...	Lungs................	Sister.
369...	30.....	F...	3 years.....	2 months...	Lungs................	Brother.
372...	26.....	F...	2 years.....	....	Lungs................	?
379...	21.....	F...	4 months...	4 weeks.....	Lungs................	?
380...	22.....	F...	3 years.....	3 months...	Gds., l'gs, peri'neum.	Sister.
387...	25.....	F...	1 year......	3 months...	Lungs................	?
397...	25.....	M...	2 years.....	1 month....	Lungs................	Heredity.
401...	23.....	F...	6 months...	2 months...	Larynx and lungs...	Family.
403...	21.....	F...	8 days.....	8 days......	Meninges	?
404...	22.....	M...	6 months...	1 month....	Lungs................	?
408...	22.....	F...	4 months...	6 weeks.....	Lungs................	Family.
409...	29.....	M...	7 months...	3 months..	Lungs................	Fiancé.
410...	28.....	F...	1 year......	5 months...	Lungs................	Mother.
414...	27.....	M...	3 months...	2 weeks....	Lungs.....	?
415...	25.....	M...	4 years.....	2 weeks....	Pleura and Lungs..	?
416...	24.....	M...	2 years.....	4 months...	Lungs................	?

Females ....61=53.5%
Males...53=46.5%

Total..114

31 TO 40 YEARS.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
2...	32.....	F...	?............	2 weeks....	Lungs................	?
3...	38.....	F...	2 years	2 months..	Lungs................	2 sisters.
6...	33.....	M...	3 years	1 week.....	Lungs................	Mother.
8...	35.....	F...	7 months..	2 months..	Lungs................	Mother.
11...	39.....	M...	7 years	1 day......	Lungs................	?
26...	34.....	F...	2 months..	2 months..	Glands................	Sister.
27...	37.....	M...	3 years	2 months..	Lungs................	?
43...	34.....	M...	1 year	10 months..	Psoas abscess........	?
53...	38.....	M...	2 years	6 months..	Lungs................	?
62...	41.....	F...	2 years	2 months..	Lungs................	?
70...	37.....	F...	5 years	....	Tarsal bones	?
71...	38.....	F...	1 year	3 months..	Intestines, lungs, larynx	?
72...	34.....	M...	6 months..	2 months..	Lungs................	?
81...	37.....	F...	1 year	6 months..	Lungs................	?
87...	32.....	F...	3 years	1 month...	Lungs................	?
91...	33.....	F...	6 years	10 months..	Lungs................	Cousins, Norway.
94...	39.....	M...	8 months..	2 months..	Lungs................	?
96...	35.....	M...	3 years	9 weeks....	Lungs................	?
97...	39.....	M...	18 months.	3 months..	Lungs................	?
99...	36.....	M...	2 years	10 days.....	Lungs................	Room mate.
101...	35.....	F...	1 year	2 months..	Lungs.......	Followed la grippe.
104...	40.....	F...	2 months..	5 weeks....	Lungs................	Brother.
106...	39.....	F...	13 months..	2 months..	Lungs................	?
118...	35.....	F...	1 year	5 months..	Lungs................	?
120...	37.....	F...	....	....	Lungs................	?
121...	35.....	F...	2 years	10 weeks ...	Lungs................	?
125...	33.....	F...	3 years	3 months..	Lungs................	?
126...	36.....	F...	2½ years ..	4 months..	Lungs................	?
132...	31.....	M...	....	2 weeks....	Lungs................	?
141...	40.....	M...	1 year	3 months..	Lungs................	?
143...	48.....	F...	3 years	1 year	Lungs................	?
145...	38.....	F...	Years.......	3 months..	Lungs...	?
147...	31.....	M...	2 years	2 months..	Lungs................	?
150...	33.....	F...	7 months..	7 months..	Lungs................	Old house.
168...	38.....	M...	10 years	1 year	Lungs................	Brother.
170...	37.....	F...	2 years	6 months..	Lungs................	?
172...	32.....	M...	1 year	1 year	Lungs................	?

TABLE VI.—Continued.

31 TO 40 YEARS.—Continued.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
174...	32.....	F...	Years.......	Years.......	Lungs................	?
181...	37.....	F...	1 year.....	3 months..	Lungs................	?
184...	35.....	F...	Years.......	1 month...	Lungs................	Father and brother.
200...	34.....	M...	2 years....	2 days......	Lungs................	?
211...	38.....	F...	2 years....	4 months..	Lungs................	Aunts and uncles.
223...	33.....	M...	18 months..	10 months..	Lungs and bowels...	?
228...	33.....	F...	3 years....	4 weeks....	Lungs................	?
229...	31.....	M...	3 years....	2 months..	Lungs................	Family?
230...	39.....	M...	3 months..	3 months..	Lungs................	?
233...	38.....	M...	5 months..	4 months..	Lungs................	?
236...	32.....	M...	1 year.....	....	....	
246...	31.....	F...	1 year.....	3 months..	Lungs................	?
252...	37.....	M...	1 year.....	2 months..	Lungs................	Heredity.
254...	36.....	F...	4 years....	3 months.	Lungs................	Family.
255...	40.....	M..	....	1 month...	Intestines............	?
267...	39.....	M...	3 years....	18 months..	Lungs................	Followed la grippe.
296...	31.....	F...	2 years....	5 weeks....	Lungs................	Mother and sister.
302...	36.....	F...	2 years....	3 months..	Lungs................	?
303...	39.....	M...	2 years....	3 weeks....	Lungs................	Sister.
304...	39.....	M...	10 months..	2 months..	Larynx and lungs...	?
311...	35.....	F...	1 year.....	3 months..	Lungs................	Family.
312...	32.....	F...	4 years....	10 months..	Lungs................	?
321...	37.....	M...	2 years....	3 weeks....	Lungs................	?
338...	40.....	F...	1 year.....	2 months..	Lungs................	?
345...	32.....	F...	1 year.....	6 months..	Lungs................	?
353...	35.....	M...	9 months..	1 month...	Testicle and lungs...	Family.
362...	38.....	M...	18 months..	1 month...	Lungs................	Followed la grippe.
367...	34.....	M...	6 months..	6 months..	Pharynx and lungs..	?
374...	40.....	F...	8 years....	2 weeks....	Lungs................	First husband.
376...	37.....	M...	4 years....	1 year.....	Lungs................	Brother.
377...	38.....	F...	4 years....	4 months..	Lungs................	Husband's first wife.
384...	34.....	M...	20 years....	2 years....	Lungs................	Family.
386...	31.....	F...	3 years....	3 months..	Peritoneum, lungs...	?
390...	39.....	F...	2 years....	7 months..	Hip joint, lungs......	?
400...	32.....	F...	6 months..	4 months..	Lungs................	Husband.
412...	33.....	M...	3 years....	3 weeks....	Lungs................	Family.
413...	35.....	M...	4 months..	4 months..	Intestines...........	? (Butcher).
418...	40.....	M...	1 year....	3 months..	Lungs................	?
419...	36.....	F...	3 years....	2 months..	Lungs................	Mother.

Females ....41=54%
Males ....35=46%

Total..76

41 TO 50 YEARS.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
4...	42.....	M...	2 years.....	2 months...	Larynx, lungs.......	?
5...	50.....	M...	3 months...	3 weeks....	Lungs................	Street sweepings.
15...	46.....	F...	1 year.....	4 months...	Lungs................	?
22...	42.....	M...	Years.......	6 months...	Lungs................	?
29...	42.....	F...	2 years.....	2 years.....	Lungs................	?
30...	41.....	M...	?...........	2 months...	Intestines............	?
35...	43.....	M...	2 years.....	6 months...	Lungs................	?
41...	46.....	M...	2 months...	1 month....	Lungs................	?
69...	44.....	F..	3 years......	3 weeks.....	Lungs................	Husband's first wife.
75...	44.....	M...	Years.......	3 months...	Lungs................	?
86...	48.....	M...	20 years...	2 weeks.....	Lungs................	?
103...	46.....	F...	4 months...	4 months...	Lungs................	?
115...	45.....	M...	2 years.....	1 month....	Lungs................	?
117...	42.....	M...	2 years.....	....	Lungs................	Wife and children.
123...	44.....	M...	3 years.....	6 months...	Lungs................	Heredity.
131...	48.....	F...	10 years....	3 months...	Lungs................	?
136...	43.....	M...	1 year......	2 weeks.....	Lungs................	?
137...	48.....	M...	3 years.....	3 months...	Lungs................	?
146...	41.....	F....	6 months...	4 months...	Lungs................	?
151...	44.....	M...	2 years.....	6 months...	Lungs................	Home.
169...	42.....	F....	Months	Months	Lungs................	?
173..	41.....	M...	2 years.....	3 months...	Lungs...............	Followed la grippe.

TABLE VI.—Continued.

41 TO 50 YEARS.—Continued.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
194...	45.....	M...	2 years.....	2 months...	Lungs................	A miller.
195...	45.....	M...	3 weeks.....	3 weeks	Lungs................	?
196...	41.....	F...	10 months..	2 months...	Lungs................	?
205...	49.....	M...	7 years.....	12 days.....	Lungs................	Daughters and others.
207...	50.....	M...	2 years.....	3 months...	Lungs................	?
212...	42.....	F....	3 years.....	2 years.....	Lungs................	?
221...	44.....	M...	1 year......	2 months...	Lungs................	?
222...	43.....	F....	....	....	....	
225. .	45.....	M...	5 years.....	3 months...	Pleura and lungs....	?
231...	48.....	M...	3 months...	3 months...	Peritoneum	?
234...	45.....	M...	2½ years...	5 months...	Lungs................	Heredity.
242...	50.....	M...	3 years.....	1 year......	Lungs................	?
243...	49.....	F....	7 years.....	3 months...	Lungs................	Family.
249...	49.....	F....	9 years......	2 months...	Lungs................	Brother.
259...	49.....	F....	6 months...	5 months...	Lungs................	Son and daughter.
276...	47.....	F....	2 years.....	1 month....	Lungs................	?
277...	49.....	F. ..	10 months..	3 months...	Lungs................	Followed la grippe.
285...	47.....	F....	3 years.....	2 weeks....	Lungs................	Family.
289...	47.....	M...	Months	4 months...	Lungs................	(Miner).
290..	50.....	M...	2 years.....	9 months...	Intestines............	(Army)?
295...	44.....	F....	5 years.....	3 months...	Peritoneum..........	?
301...	50.....	M...	1 year......	Days	Lungs................	Wife.
304...	50.....	F...	20 years....	4 months...	Lungs................	?
307...	42.....	F....	2 years.....	6 months..	Lungs................	?
308...	45.....	F....	10 years....	....	Lungs................	?
310...	42.....	M...	1 year......	2 months...	Lungs................	Family.
314...	42.....	M...	....	....	Lungs................	Family.
316...	49.....	F....	10 years....	1 year......	Tibia and lungs......	?
318...	42.....	M...	1 year......	6 weeks.....	Lungs................	?
336...	41.....	F...	4 years.....	6 months...	Lungs................	?
339...	45.....	F....	8 months...	3 months...	Lungs................	Son.
340...	43.....	M...	4 years.....	2 months...	Lungs................	?
346...	42.....	F....	....	2 months....	Lungs................	?
348...	41.....	M...	1 year......	8 months...	Lungs................	?
356...	44.....	M...	18 months..	8 months...	Lungs................	Family
364...	44.....	M...	Years.......	1 year	Knee, Lungs..........	?
368...	48.....	M...	5 years.....	3 months...	Lungs................	?
370...	45.....	F....	1 year......	....	Lungs................	?
375...	50.....	M...	2 years.....	4 months...	Lungs................	?
380...	50.....	M...	6 years.....	1 year......	Lungs................	Sister.
383...	42.....	F...	2 years.....	....	Lungs................	?
388...	42.....	M...	3 months...	1 month....	Lungs and bowels...	?
394...	47.....	M...	2 years.....	6 months...	Throat and lungs...	?
407...	45.....	M...	8 months...	1 month....	Throat and lungs...	?
411...	49.....	F....	18 months..	3 weeks.....	Larynx and lungs...	?
416...	44.....	F....	18 months..	3 months...	Lungs................	?

Females .... 28=41 %.
Males... 40=59 %.

Total 68

51 TO 60 YEARS.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
21...	54.....	M...	....	....	....	?
25...	59.....	F....	5 years.....	1 year......	Lungs................	Family.
37...	57.....	M...	2 years.....	6 months...	Intestines............	?
44...	58.....	M...	7 months...	1 month....	Lungs................	?
52...	58.....	F....	1 year......	3 months...	Lungs................	?
60..	59.....	M...	2 years......	3 months...	Lungs................	?
61...	54.....	F....	7 months...	1 week......	Lungs................	Following pneumonia.
98...	52.....	F....	2 years.....	3 months...	Lungs................	2 daughters.
112...	60.....	M...	15 years....	....	Lungs................	?
130...	52.....	F....	3 years......	10 days.....	Lungs................	?
154...	57.....	M...	2 years.....	6 months...	Lungs................	?
161...	53....	M...	2 years.....	6 weeks....	Lungs................	Heredity.
166...	60.....	M...	Years.......	1 week......	Lungs................	?
179...	53.....	F....	6 months?..	2 months...	Lungs................	Son-in-law.
180...	53.....	M...	....	... .	Lungs................	?

TABLE VI.—Continued.

51 TO 60 YEARS.—Continued.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
186...	58.....	M...	20 years....	2 months...	Lungs................	Daughter.
193...	57.....	M...	18 months..	4 months...	Lungs................	?
199...	53.....	F....	9 months...	2½ months.	Lungs................	Brother.
204...	51.....	F....	2 years.....	4 months...	Lungs................	Husband.
214...	56.....	F....	4 years.....	8 months...	Lungs................	?
232...	53.....	M...	6½ months.	4 months...	Lungs................	?
247...	60.....	M...	1 year......	2 months...	Lungs................	?
250...	51.....	M...	1 year.. ...	3 months...	Stomach, lungs.......	A stone cutter.
260...	60.....	F....	12 years....	3 months...	Lungs................	?
294...	51.....	M...	....	10 days.....	Pulm. Hem...........	?
299...	56.....	M...	15 months..	5 months...	Lungs................	Following la grippe.
341...	60.....	F....	6 months...	6 weeks.....	Lungs................	Son.
359...	53.....	M...	13 years....	4 months...	Lungs................	Family.
361...	57.....	M...	....	2 months...	Lungs................	?
391...	54.....	F....	5 months...	2 months...	Lungs................	?
392...	52.....	M...	8 months...	7 months...	Rectal fissure, lungs.	?
405...	59.....	M...	18 months..	2 weeks.....	Lungs................	Family.

Females.. 12=37.5%
Males... 20=62.5%

Total.. 32

61 YEARS AND UPWARDS.

No.	Age.	Sex.	Duration of Illness.	Confined to House.	Parts Involved.	Cases in Family or Source of Infection.
12...	68.....	M ..	1 year......	3 months...	Lungs................	?
20...	70.....	F....	?............	1 week.....	Lungs................	?
54...	73.....	F....	?............	?........ ...	Lungs................	?
66...	75.....	F....	18 months..	2 months...	Lungs................	?
68...	68.....	M...	1 year......	1 month....	Lungs......	A miller.
110...	63.....	M...	1 year......	3 months...	Lungs................	?
155...	63.....	M...	Years.......	1 month....	Intestines............	Heredity.
178...	73.....	F....	Years.......	4 months...	Lungs................	?
182...	69.....	F....	....	3 months...	Intestines............	?
189...	74.....	M...	20 years....	1 month....	Lungs.........	?
210...	74.....	M...	6 months...	1 month....	Lungs................	?
219...	67.....	F....	18 months .	1 year......	Lungs................	Grandson.
235...	63.....	M...	4 years.....	1 month....	Lungs................	Nephew?
248...	63.....	M...	....	6 weeks.....	Lungs................	?
251...	61.....	M...	....	8 weeks.....	Lungs................	?
253...	77.....	M...	4 years.....	3 months...	Lungs................	Followedpneumonia.
283...	74.....	M...	3 months...	2 weeks.....	Lungs................	?
325...	68.....	F....	8 months?..	1 month....	Lungs................	Daughter.
326...	68.....	F....	4 years.....	6 weeks.....	Lungs................	?
337...	80.....	F....	2 years.....	3 months...	Lungs................	?
343...	65.....	F....	3 years.....	2 months...	Lungs................	Heredity.
349...	61.....	F.. .	4 weeks....	4 weeks.....	Lungs................	?
406...	62.....	F....	6 months...	6 months...	Lungs................	Sons.

Females.. 12=52+%
Males... 11=48−%

Total.. 23

Grand total: Males.. 203
Females.. 210

413

It is worthy of note that the total deaths recorded in Table VI, does not differ materially for the two sexes as shown by the following summary:

	Males.	Females.
Years 1 to 10 inclusive	25	17
Years 11 to 20 inclusive	19	39
Years 21 to 30 inclusive	53	61
Years 31 to 40 inclusive	35	41
Years 41 to 50 inclusive	40	28
Years 51 to 60 inclusive	20	12
Above 60 years	11	12
Totals	203	210

In considering the subject of tuberculosis, attention should be drawn to the able papers read before the Minnesota Sanitary Conference at St. Paul, January, 1902, by Dr. C. L. Greene, Dr. H. L. Taylor, and Prof. H. L. Russell and discussion (see pages 51 to 75).

SMALLPOX.

The remarkable epidemic of smallpox in this state has continued up to the present time. A map showing the places invaded up to Jan. 1, 1902, is given opposite page 98. Since that date the cases for the rest of this biennial period are shown in the accompanying table.

TABLE VII.

Smallpox in Minnesota Jan. 1 to Aug. 1, 1902.

Locality.	Cases.	Deaths.	Total Cases.
AITKIN COUNTY—			
Aitkin, c	13	....	
4 townships	7	....	
			20
ANOKA COUNTY—			
Anoka, c	4	....	
4 townships	33	....	
			37
BECKER COUNTY—			
Detroit, c	3	....	
Frazee, v	9	....	
11 towships	72	....	
			84
BELTRAMI COUNTY—			
Bagley, v	5	....	
Bemidji, v	180	....	
Farley, v	13	....	
Selkce, v	2	....	
Solway, v	6	....	
Ten Strike, v	4	....	
13 townships	59	1	
			269
BENTON COUNTY—			
Sauk Rapids, v	2	....	
3 townships	9	....	
			11
BIG STONE COUNTY—			
Beardsley, v	33	2	
Graceville, v	3	....	
8 townships	35	....	
			71
BLUE EARTH COUNTY—			
Garden City, v	3	....	
Good Thunder, v	1	....	
Madison Lake, v	14	....	
Mankato, c	137	....	
Mapleton, v	58	....	
9 townships	70	....	
			283
BROWN COUNTY—			
Comfrey, v	5	....	
Sleepy Eye, v	6	....	
2 townships	7	....	
			18
CARLTON COUNTY—			
Carlton, v	5	....	
2 townships	2	....	
			7
CARVER COUNTY—			
Benton, v	6	....	
Chanhassen, v	24	....	
Chaska, c	8	....	
Cologne, v	11	....	
Mayer, v	1	....	
Norwood, v	1	....	
Waconia, v	46	....	
Watertown, v	12	....	
Young America, v	2	....	
11 townships	261	1	
			372

TABLE VII.—Continued.

Locality.	Cases.	Deaths.	Total Cases.
CASS COUNTY—			
Cass Lake, v.	16	....	
Pillager, v.	1	....	
Walker, v.	13	....	
6 townships	37	....	67
CHIPPEWA COUNTY—			
Maywood, v.	2	....	
Montevideo, v.	12	....	
5 townships	14	....	28
CHISAGO COUNTY—			
North Branch, v.	1	....	
2 townships	6	....	7
CLAY COUNTY—			
Barnesville, c.	12	....	
Glyndon, v.	2	....	
Hawley, v.	10	....	
Winnipeg Junct., v.	3	....	
18 townships	159	1	186
COTTONWOOD COUNTY—			
Bingham Lake, v.	1	....	
Windom, v.	7	....	
6 townships	39	....	47
CROW WING COUNTY—			
Brainerd, c.	62	1	
9 townships	73	1	135
DAKOTA COUNTY—			
Hastings, c.	9	....	
Rosemount, v.	3	....	
So. St. Paul, c.	10	....	
6 townships	18	....	40
DODGE COUNTY—			
West Concord, v.	1	....	
4 townships	12	....	13
DOUGLAS COUNTY—			
Evansville, v.	1	....	
Osakis, v.	1	....	
8 townships	20	....	22
FARIBAULT COUNTY—			
Blue Earth, v.	27	....	
Bricelyn, v.	1	....	
Kiester, v.	1	....	
Minnesota Lake, v.	1	....	
Winnebago City, v.	9	....	
8 townships	29	....	68
FILLMORE COUNTY—			
Preston, v.	1	....	
Rushford, c.	1	....	
Spring Valley, v.	5	....	
Wykoff, v.	10	....	
7 townships	21	....	38
FREEBORN COUNTY—			
Albert Lea, c.	5	....	
Alden, v.	1	....	
9 townships	26	1	32
GOODHUE COUNTY			
Kenyon, v.	5	....	
Pine Island, v.	7	....	
Red Wing, c.	12	....	
Zumbrota, v.	5	....	
11 townships	126	1	155
GRANT COUNTY—			
Hoffman, v.	1	....	
4 townships	5	....	6
HENNEPIN COUNTY—			
Excelsior, v.	1	....	
Golden Valley, v.	14	....	
Hopkins, v.	4	....	
Minneapolis, c.	333	....	
St. Bonifacius, v.	10	....	
St. Louis Park, v.	2	....	
Wayzata, v.	2	....	
15 townships	227	2	593
HOUSTON COUNTY—			
Brownsville, v.	1	....	
Caledonia, v.	12	....	
Hokah, v.	3	....	
Houston, v.	4	....	
Spring Grove, v.	1	....	
10 townships	60	1	81
HUBBARD COUNTY—			
Akely, v.	30	....	
Farris, v.	5	....	
Hubbard, v.	4	....	
Nary, v.	5	....	
Park Rapids, v.	47	....	
15 townships	138	2	229
ISANTI COUNTY—			
4 townships	22	....	22
ITASCA COUNTY—			
Deer River, v.	9	....	
Grand Rapids, c.	42	....	
Swan River, v.	1	....	52
JACKSON COUNTY—			
Heron Lake, v.	15	....	
Jackson, v.	61	....	
8 townships	84	....	160
KANABEC COUNTY—			
6 townships	33	....	33
KANDIYOHI COUNTY—			
Atwater, v.	4	....	
Willmar, c.	5	....	
7 townships	48	....	57
KITTSON COUNTY—			
Hallock, v.	3	....	
St. Vincent, v.	2	....	
7 townships	40	....	45
LAC QUI PARLE CO.—			
Boyd, v.	1	....	
Dawson, v.	2	....	
Madison, v.	3	....	
Marietta, v.	1	....	
5 townships	13	....	20
LAKE COUNTY—			
Two Harbors, v.	15	....	15
LE SUEUR COUNTY—			
Montgomery, v.	4	....	
Waterville, v.	11	....	
4 townships	8	....	23

TABLE VII.—Continued.

Locality.	Cases.	Deaths.	Total Cases.
LINCOLN COUNTY—			
Hendricks, v.	4	....	
Ivanhoe, v.	14	1	
Lake Benton, v.	7	....	
Tyler, v.	13	....	
8 townships	166	....	
			204
LYON COUNTY—			
Balaton, v.	1	....	
Marshall, v.	22	....	
Russell, v.	1	....	
Tracy, v.	3	....	
7 townships	70	....	
			97
McLEOD COUNTY—			
Hutchinson, v.	6	....	
Silver Lake, v.	2	....	
Stewart, v.	4	....	
Winsted, v.	9	....	
3 townships	6	....	
			27
MARSHALL COUNTY—			
Argyle, v.	17	1	
Warren, v.	1	....	
16 townships	79	1	
			97
MARTIN COUNTY—			
Fairmont, v.	19	....	
Granada, v.	6	....	
Sherburn, v.	18	....	
9 townships	60	....	
			103
MEEKER COUNTY—			
Forest City, v.	5	....	
Lester Prairie, v.	2	....	
Litchfield, v.	6	....	
10 townships	73	....	
			86
MILLE LACS COUNTY—			
Milaca, v.	10	....	
Princeton, v.	2	....	
8 townships	86	....	
			98
MORRISON COUNTY—			
Little Falls, c.	6	....	
Pierz, v.	4	....	
Royalton, v.	3	....	
10 townships	101	....	
			114
MOWER COUNTY—			
Austin, c.	1	....	
Le Roy, v.	1	....	
Taopi, v.	6	....	
8 townships	37	1	
			45
MURRAY COUNTY—			
5 townships	17	....	
			17
NICOLLET, COUNTY—			
No. Mankato, v.	16	....	
St. Peter, c.	12	....	
4 townships	11	....	
			39
NOBLES COUNTY—			
Adrian, v.	5	....	
Wilmont, v.	12	....	
Worthington, v.	7	....	
5 townships	89	....	
			113
NORMAN COUNTY—			
Hendrum, v.	6	....	
Perley, v.	1	....	
Twin Valley, v.	6	....	
10 townships	51	1	
			64

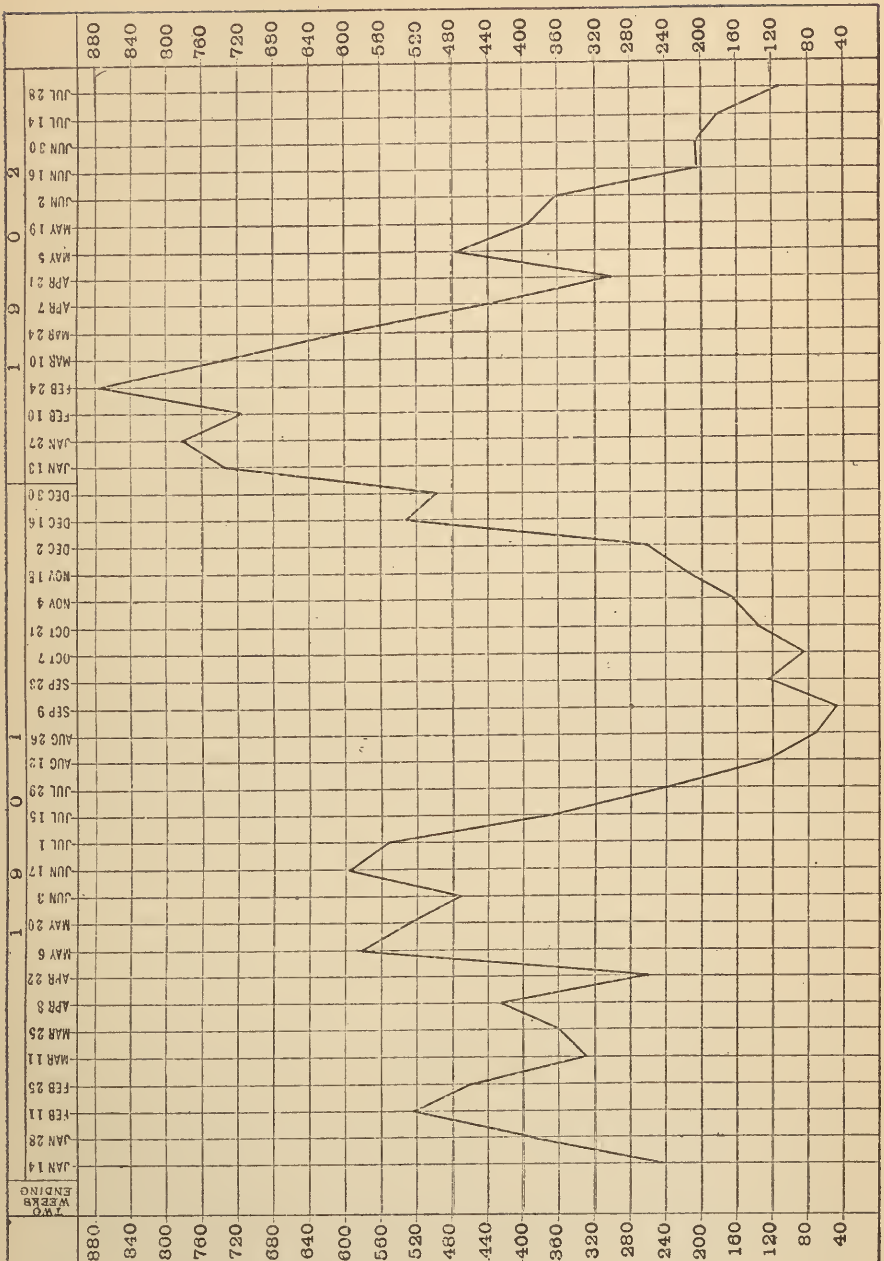
Locality.	Cases.	Deaths.	Total Cases.
OLMSTED COUNTY—			
Eyota, v.	8	....	
Rochester, c.	1	....	
Stewartville, v.	5	....	
10 townships	39	....	
			53
OTTER TAIL COUNTY—			
Fergus Falls, c.	17	....	
Henning, v.	7	....	
Perham, v.	20	....	
29 townships	169	....	
			213
PINE COUNTY—			
Hinckley, v.	14	....	
Sandstone, v.	1	....	
Willow River, v.	34	....	
1 township	1	....	
			50
PIPESTONE COUNTY—			
Edgerton, v.	2	....	
Jasper, v.	10	....	
Pipestone, c.	144	1	
Ruthton, v.	1	....	
Trosky, v.	20	....	
Woodstock, v.	24	....	
11 townships	81	....	
			282
POLK COUNTY—			
Climax, v.	11	....	
Crookston, c.	31	....	
E. Grand Forks, c.	19	....	
Fertile, v.	13	....	
Fisher, v.	6	....	
McIntosh, v.	16	....	
27 townships	120	....	
			216
POPE COUNTY—			
4 townships	25	....	
			25
RAMSEY COUNTY—			
St. Paul, c.	102	....	
2 townships	15	....	
			117
RED LAKE COUNTY—			
Red Lake Falls, v.	5	....	
St. Hilaire, v.	21	....	
Thief River Falls, v.	33	....	
5 townships	86	3	
			145
REDWOOD COUNTY—			
Lamberton, v.	3	....	
Morgan, v.	3	....	
Redwood Falls, c.	5	....	
Wabasso, v.	7	....	
7 townships	89	1	
			107
RENVILLE COUNTY—			
Fairfax, v.	2	....	
Morton, v.	3	....	
Renville, v.	3	....	
6 townships	42	....	
			50
RICE COUNTY—			
Dundas, v.	6	....	
Faribault, c.	22	....	
Northfield, c.	12	....	
8 townships	24	....	
			64
ROCK COUNTY—			
Hardwick, v.	6	....	
Hills, v.	15	....	
Luverne, v.	6	....	
10 townships	66	....	
			93

TABLE VII.—Continued.

Locality.	Cases.	Deaths.	Total Cases.
ROSEAU COUNTY—			
Badger, v	2	....	
Roseau, v	5	....	
4 townships	33	....	
			40
ST. LOUIS COUNTY—			
Biwabik, v	4	....	
Buhl, v	6	....	
Duluth, c	149	....	
Ely, c	7	....	
Eveleth, v	9	....	
Hibbing, v	35	....	
Proctor Knott, v	8	....	
Tower, c	1	....	
Virginia, v	4	....	
2 townships	19	....	
			242
SCOTT COUNTY—			
Belle Plaine, v	2	....	
New Market, v	5	....	
Shakopee, c	2	....	
6 townships	52	....	
			61
SHERBURNE COUNTY—			
Elk River, v	1	....	
3 townships	23	1	
			24
SIBLEY COUNTY—			
Gaylord, v	2	....	
Gibbon, v	2	....	
5 townships	20	....	
			24
STEARNS COUNTY—			
Albany, v	7	....	
Freeport, v	5	....	
Melrose, v	7	....	
Richmond, v	1	....	
St. Cloud, c	49	....	
St. Joseph, v	12	....	
Sauk Centre, v	10	....	
Torah, v	2	....	
10 townships	89	....	
			182
STEELE COUNTY—			
Blooming Grove, v	1	....	
Owatonna, c	23	....	
4 townships	19	....	
			43
STEVENS COUNTY—			
Morris, v	7	....	
1 township	8	....	
			15
SWIFT COUNTY—			
Appleton, v	1	....	
Benson, v	2	....	
De Graff, v	9	....	
Murdock, v	2	....	
4 townships	24	....	
			38
TODD COUNTY—			
Bertha, v	7	....	
Clarissa, v	1	....	
Eagle Bend, v	15	....	
Grey Eagle, v	10	....	
Hewitt, v	4	....	
Long Prairie, v	3	....	
Staples, v	43	....	
13 townships	94	....	
			177
TRAVERSE COUNTY—			
Wheaton, v	2	....	
6 townships	96	....	
			98
WABASHA COUNTY—			
Hammond, v	2	....	
Lake City, c	1	....	
Zumbro Falls, v	5	....	
7 townships	35	....	
			43
WADENA COUNTY—			
Wadena, v	5	....	
10 townships	35	....	
			40
WASECA COUNTY—			
Waseca, c	14	....	
6 townships	80	....	
			94
WASHINGTON COUNTY—			
Newport, v	1	....	
So. Stillwater, v	14	....	
Stillwater, c	24	....	
5 townships	31	....	
			70
WATONWAN COUNTY—			
St. James, c	19	....	
4 townships	8	....	
			27
WILKIN COUNTY—			
Rothsay, v	4	....	
4 townships	7	....	
			11
WINONA COUNTY—			
Dresbach, v	11	....	
Lewiston, v	2	....	
Winona, c	16	....	
4 townships	14	....	
			43
WRIGHT COUNTY—			
Annandale, v	1	....	
Buffalo, v	1	....	
Clearwater, v	4	....	
Delano, v	7	....	
Hanover, v	3	....	
Howard Lake, v	3	....	
Rockford, v	13	....	
Waverly, v	1	....	
11 townships	57	....	
			90
YELLOW MEDICINE CO.—			
Canby, v	1	....	
Wood Lake, v	9	....	
9 townships	45	....	
			55

Total cases 7,282
Total deaths 25
Number of localities 853

The progress of the disease from Jan. 1 to Aug. 1, 1902, is well shown in the accompanying diagram.


TWO WEEKS ENDING
1901
1902
JAN 14
JAN 28
FEB 11
FEB 25
MAR 11
MAR 25
APR 8
APR 22
MAY 6
MAY 20
JUN 3
JUN 17
JUL 1
JUL 15
JUL 29
AUG 12
AUG 26
SEP 9
SEP 23
OCT 7
OCT 21
NOV 4
NOV 18
DEC 2
DEC 16
DEC 30
JAN 13
JAN 27
FEB 10
FEB 24
MAR 10
MAR 24
APR 7
APR 21
MAY 5
MAY 19
JUN 2
JUN 16
JUN 30
JUL 14
JUL 28
880
840
800
760
720
680
640
600
560
520
480
440
400
360
320
280
240
200
160
120
80
40

The total cases reported to the State Board of Health for 1899, 1900, 1901 and 1902 to August 1st are as follows:

	Cases.	Deaths.
1899	275	11
1900	1,371	22
1901	8,485	43
1902 (7 months)	7,282	25
Total	17,393	101

In all probability one could safely add to this list at least ten per cent to cover the unreported cases, making a total for the period of three years (for the epidemic did not actually begin until July, 1899) of about 20,000 cases. The mild type of the disease and the accompanying low mortality have continued up to the present date. The disease has been confined chiefly to the lumbering and country districts during the past year. Physicians quite generally recognize the disease now, and consequently the cases which have recently occurred in villages and cities have been due to importation from the country districts. The general prevalence of smallpox in the lumber camps and country districts has been due largely to neglect in calling a physician upon the appearance of the disease, either because the patient was not sufficiently ill to need attention or because the people wished to evade quarantine. The general epidemic should decrease from this time on, for residents in the country districts should be largely immune, either through having had the disease or because of successful vaccination, and the residents of villages and cities now realize that the financial demoralization following the appearance of the disease in their midst is such as to demand constant watchfulness. It is now generally understood that people do not want smallpox, even though it is mild in type. It remains to be seen what the future will bring forth in the lumbering districts. While some of the lumbering men are watchful and careful, others are quite the reverse. It is no uncommon thing for a man to be paid his wages, and sent out of camp during the prodromal stage of smallpox, before the eruption has appeared. Of course, such action is generally followed by much exposure and demoralization in neighboring camps or villages. Occasionally we find unprincipled men in charge of camps, as illustrated near Hibbing, where a lumberman hauled one of his employes suffering from smallpox near to the village and told him to report himself in the village as having come from Wisconsin instead of from a camp near

by. This lumberman should have been prosecuted, but for some unexplained reason no such action was taken against him. There should be some provision in the law compelling those who employ large numbers of men who have in fact no place of residence to care for them when sick. It is a fact that the people in the mining and milling villages have proper medical and hospital care for employes, but such action is rarely taken in lumber camps. The result is, a great burden has been thrown upon the state in paying for the care of so-called non-resident smallpox, as shown in the following statement:

ACCOUNTS AGAINST THE STATE OF MINNESOTA FOR THE CARE OF NON-RESIDENT SMALLPOX CASES DUE TO INFECTION FROM LUMBERING CAMPS.

Place.	Amount Claimed.
Brainerd, c., Crow Wing county	$110.35
Duluth, c., St. Louis county	499.50
Great Scott township, St. Louis county	216.75
Duluth, c., St. Louis county	1,845.00
Burnhamville township, Todd county	162.80
Cass Lake, v., Cass county	2,868.59
Bemidji, v., Beltrami county	2,135.48
Two Harbors, v., Lake county	2,020.06
Hibbing, v., St. Louis county	3,115.26
Cambridge, v., Isanti county	71.10
Red Clover township, Carlton county	172.07
Barnum, v., Carlton county	410.31
Virginia, c., St. Louis county	429.71
Duluth, c., St. Louis county	55.50
Duluth, c., St. Louis county	54.00
Duluth, c., St. Louis county	303.00
Ben Wade township, Pope county	266.15
Deer River, v., Itasca county	150.70
Walker, v., Cass county	444.87
Grand Rapids, c., Itasca county	419.00
Total	$15,750.20

These bills do not represent the total expense of infection through lumbering camps, for many of the non-resident smallpox

cases in districts in the state remote from the lumbering region can trace their infection to men who came from lumber camps. The expense to the state for the care of smallpox from lumber camps, as shown, is $15,750.20. The expense to cities, villages, counties and townships would undoubtedly amount to one hundredfold this amount.

The plan which certain hospitals have of selling tickets needs revision. These tickets state that medical treatment will not be given when the disease is of a contagious nature. The intent, of course, is to protect the hospital from the damages attending contagious diseases. In practice, however, the custom is vicious. If a man holding a hospital ticket is taken ill, he naturally starts for the hospital upon which he holds a ticket. He may have no knowledge as to the nature of his illness. He may stop at various camps or villages on his way; he may even travel by train while suffering from smallpox, scarlet fever or diphtheria, and thus expose many people. Finally when he reaches the hospital he is told that his ticket does not entitle him to treatment of the disease from which he is suffering. Thereupon, if he is not very ill, he will probably go into some lodging house and expose many people, or, if he is very ill, he will become a public charge in the city where the hospital selling tickets is located. If hospitals sell tickets it should be to men employed in districts near by, and they should most certainly have isolation quarters in which an infectious case may be cared for. The man who is ill with smallpox or diphtheria is a victim of circumstances quite as much as he who may have his leg broken, and is entitled to proper medical care. As a matter of fact, the selling of hospital tickets to men should be unqualifiedly condemned. It is the employer that should make provision for his employes. This he should be able to do by deducting a small amount weekly or monthly from their wages, and with this he should provide for the medical or surgical care of those under him at the nearest possible point to the place of employment. I am aware that this withholding of wages is often looked upon by the men as an injustice, but it certainly cannot be so considered when the suffering and exposure which so often follows a lack of such provision is taken into account. The law should *compel* such protective action upon the part of employes and should provide inspection that would insure the proper expenditure of money withheld for such a purpose.

VACCINATION.

The decision of the courts supporting the right of exclusion of non-vaccinated children from schools when smallpox is epidemic

will be of great benefit to sanitary officials throughout the state in the future. In the past there has been much indecision on the part of local boards of health and of school boards in carrying out the instruction of the State Board of Health in such matters.

If, in the future, smallpox should serve as a demoralizing element in the schools of our cities or villages, the school boards will have to bear the responsibility. It is strange indeed that so many people of the faddist type should be found in the enlightened country who will place their theoretical arguments against well demonstrated facts. No one but a fanatic can resist the positive evidence as to the protective power of vaccination against smallpox.

SCARLET FEVER.

This disease continues to prevail throughout the state, as shown in table VIII.:*

From Jan. 1 to Nov. 1, 1900 (ten months), there were reported to this board 1,032 cases with 62 deaths. (See last biennial report, page 46.)

From Nov. 1, 1900, to Aug. 1, 1901 (twenty-one months), we have knowledge of 3,499 cases with 194 deaths.

The imperfect morbidity returns are emphasized by this table. It is the duty of local health officers to make prompt returns of *all cases* and *all deaths* from contagious diseases to the State Board of Health. We have knowledge, as shown in the table, of 385 cases and 121 deaths from scarlet fever, of which we have no official report from local authorities.

The death rate has not changed materially. In 1900 it was about 4.7 per 1,000 deaths, in 1901 it was about 4.4 per 1,000 deaths.

In our last report reference was made to the mild type of the disease, and also to the tendency of some physicians to conceal its presence in order to protect their clients from quarantine by giving it some other than its true name. This was forcibly illustrated in Hopkins village, a suburb of Minneapolis, when *three* of the local physicians persisted in calling scarlatine *German measles*. In consequence of such action on their part there were thirty-nine cases with one death reported to this office before the local epidemic ceased.

The following table gives a twenty-one months' record for scarlet fever, and also shows the sources from which we get our information:

For further statistics on scarlet fever, see Tables I., II., III., IV.

TABLE VIII.

Scarlet Fever Record from Nov. 1, 1900, to Aug. 1, 1902 (21 months).

Locality.	Known Cases Reported by: Health Officers.	Death Returns.	News-papers.	Physi-cians.	Total: Cases.	Deaths.
AITKIN COUNTY—						
Aitkin, city	1	......	1	......	2	......
ANOKA COUNTY—						
Anoka, city	......	......	......	6	6	......
Four townships	3	1	......	......	4	1
BECKER COUNTY—						
Detroit, city	3	......	......	......	3	1
Frazee, village	2	......	......	......	2	......
Two townships	7	......	......	......	7	1
BELTRAMI COUNTY—						
Bemidji, village	1	......	......	1	2	......
Black Duck, village	1	......	......	......	1	......
BENTON COUNTY—						
Foley, village	4	......	......	1	5	......
Ronneby, village	1	......	......	......	1	......
Sauk Rapids, village	......	2	......	......	2	2
Three townships	......	1	......	12	13	1
BIG STONE COUNTY—						
Beardsley, village	......	1	......	......	1	1
Graceville, village	1	......	......	......	1	......
Odessa, village	6	......	......	......	6	......
Ortonville, city	2	1	......	......	3	1
Four townships	5	......	......	......	5	1
BLUE EARTH COUNTY—						
Amboy, village	6	......	......	......	6	1
Mankato, city	50	......	......	......	50	1
Eleven townships	22	2	......	9	33	5
BROWN COUNTY—						
New Ulm, city	25	......	......	3	28	1
Sleepy Eye, village	3	......	......	......	3	1
Springfield, village	1	......	......	......	1	......
Two townships	10	......	......	......	10	1
CARLTON COUNTY—						
Cloquet, village	42	......	......	......	42	5
Moose Lake, village	2	......	......	......	2	......
Two townships	......	11	......	......	11	11
CARVER COUNTY—						
Watertown, village	3	......	......	......	3	......
Three townships	6	......	......	4	10	......
CHIPPEWA COUNTY—						
Montediveo, village	......	......	2	......	2	......
CHISAGO COUNTY—						
Stacy, village	1	......	......	......	1	......
Taylors Falls, village	5	......	......	......	5	......
Two townships	1	......	1	......	2	......
CLAY COUNTY—						
Hawley, village	2	......	......	......	2	......
Moorhead, city	......	......	2	......	2	......
Ulen, village	1	......	......	......	1	......
Four townships	5	......	......	......	5	......
COTTONWOOD COUNTY—						
Windom, village	2	......	......	......	2	......
Three townships	6	......	......	......	6	......
CROW WING COUNTY—						
Brainerd, city	22	......	......	3	25	1
DAKOTA COUNTY—						
Hastings, city	1	......	......	......	1	......
South St. Paul, city	......	1	......	......	1	1
West St. Paul, city	......	1	......	......	1	1
One township	1	......	......	......	1	......
DODGE COUNTY—						
Kasson, village	1	......	......	......	1	......
Four townships	2	......	3	......	5	......

TABLE VIII.—Continued.

Locality.	Known Cases Reported by: Health Officers.	Death Returns.	News-papers.	Physi-cians.	Total: Cases.	Deaths.
DOUGLAS COUNTY—						
Alexandria, village			1		1	
Osakis, village			9		9	
Three townships		4			4	4
FARIBAULT COUNTY—						
Blue Earth, city	1				1	
Winnebago, village	1				1	
One township				9	9	
FILLMORE COUNTY—						
Lanesboro, village			2		2	
Preston, village	17		9		26	
Rushford, village		1			1	1
Three townships	6		1		7	
FREEBORN COUNTY—						
Albert Lea, city	8				8	2
Two townships	2			15	17	1
GOODHUE COUNTY—						
Cannon Falls, village	2				2	
Kenyon, village	1				1	
Red Wing, city	3	1			4	1
Zumbrota, village	1				1	
Three townships	14	1	1		16	1
GRANT COUNTY—						
Elbow Lake, village		1			1	1
HENNEPIN COUNTY—						
Edina, village	20				20	
Hasson, village	1				1	
Hopkins, village	6				6	
Minneapolis, city	739				739	25
Robbinsdale, village	5				5	
Five townships	7				7	
HOUSTON COUNTY—						
Caledonia, village				11	11	
Hokah, village	2				2	
Houston, village	3				3	
Seven townships	26			11	37	
HUBBARD COUNTY—						
Hubbard, village	1				1	
ITASCA COUNTY—						
Grand Rapids, city	5				5	
One township		1			1	1
JACKSON COUNTY—						
Heron Lake, village	2		7		9	
Jackson, village	2				2	
Four townships	7				7	1
KANABEC COUNTY—						
Mora, village	2				2	
Two townships	1	1			2	1
KANDIYOHI COUNTY—						
Willmar, city		2	2	8	12	2
One township	1				1	
LAC QUI PARLE COUNTY—						
Bellingham, village	2				2	1
Dawson, village	14				14	
Madison, village	2				2	
One township	6				6	
LAKE COUNTY—						
Two Harbors, township	1				1	
LE SUEUR COUNTY—						
Le Sueur Center, village	3			2	5	
Waterville, city	1				1	
Three townships	3		2		5	
LINCOLN COUNTY—						
Lake Benton, village				4	4	
LYON COUNTY—						
Marshall, city	1				1	
Russel, village	1				1	
Tracy, village	9				9	

TABLE VIII.—Continued.

Locality.	Known Cases Reported by				Total.	
	Health Officers.	Death Returns.	News-papers.	Physi-cians.	Cases.	Deaths.
McLEOD COUNTY—						
Brownton, village	1	......	......	......	1	......
Glencoe, village	......	......	......	6	6	1
Plato, village	......	......	......	1	1	......
Stewart, village	......	......	2	......	2	......
Five townships	14	......	2	2	18	1
MARTIN COUNTY—						
Ceylon, village	2	......	......	......	2	......
Fairmont, village	2	......	2	......	4	......
Granada, village	1	......	......	......	1	......
Sherburn, village	1	......	......	......	1	......
MEEKER COUNTY—						
Litchfield, village	2	......	......	......	2	......
Five townships	4	2	......	6	12	2
MILLE LACS COUNTY—						
Three townships	4	......	......	......	4	2
MORRISON COUNTY—						
Little Falls, city	14	2	1	......	17	3
Two townships	9	......	......	......	9	4
MOWER COUNTY—						
Austin, city	......	......	......	2	2	......
Grand Meadow, village	1	......	......	......	1	......
Le Roy, village	1	......	......	......	1	......
Four townships	3	......	......	1	4	......
MURRAY COUNTY—						
Lake Wilson, village	4	......	1	......	5	......
Slayton, village	......	......	1	......	1	......
Two townships	2	2	......	......	4	2
NICOLLET COUNTY—						
North Mankato, village	......	......	......	4	4	......
NOBLES COUNTY—						
Adrian, village	4	......	......	......	4	......
Wilmont, village	1	......	......	......	1	......
Worthington, village	11	......	......	......	11	......
Two townships	5	......	......	......	5	......
NORMAN COUNTY—						
Ada, village	11	......	......	......	11	......
Gary, village	......	......	1	......	1	......
Twin Valley, village	7	......	......	......	7	......
Seven townships	11	2	......	......	13	2
OLMSTED COUNTY—						
Rochester, city	8	......	......	2	10	1
Stewartsville, village	1	......	......	......	1	......
Five townships	6	......	......	......	6	......
OTTER TAIL COUNTY—						
Fergus Falls, city	8	......	1	3	12	1
Henning, village	4	......	......	......	4	......
Parker's Prairie, village	3	......	......	......	3	......
Pelican Rapids, village	1	......	......	......	1	......
Seventeen townships	39	7	3	4	53	9
PINE COUNTY—						
Hinckley, village	18	......	......	......	18	1
Pine City, village	1	......	......	......	1	......
Sandstone, village	1	......	......	......	1	......
One township	1	......	......	......	1	......
POLK COUNTY—						
Crookston, city	1	......	......	......	1	......
East Grand Forks, city	1	......	......	......	1	......
Three townships	......	3	......	......	3	3
POPE COUNTY—						
Seven townships	3	1	12	5	21	1
RAMSEY COUNTY—						
St. Paul, city	777	......	......	......	777	30
One township	3	......	......	......	3	......
REDWOOD COUNTY—						
Vesta, village	......	......	2	......	2	......
Walnut Grove, village	1	......	......	......	1	......
Five townships	9	1	1	......	11	1

TABLE VIII.—Continued.

Locality.	Known Cases Reported by				Total.	
	Health Officers.	Death Returns.	News-papers.	Physi-cians.	Cases.	Deaths.
RENVILLE COUNTY—						
Sacred Heart, village	5				5	1
Two townships	1			5	6	
RICE COUNTY—						
Faribault, city	40				40	2
Northfield, city	3		1	4	8	
Four townships	5	1		4	10	1
ROCK COUNTY—						
Two townships	3	1			4	1
ST. LOUIS COUNTY—						
Buhl, village	4				4	
Duluth, city	253				253	9
Eveleth, village	24				24	
McKinley, village	1				1	1
Mountain Iron, village	17				17	
Proctor Knott, village		1	2		3	1
Sparta, village	1				1	
Tower, city	5				5	
Virginia, city				3	3	
West Duluth, village			2		2	
Four townships	9			1	10	
SCOTT COUNTY—						
Hamilton, village	3				3	
Shakopee, city	11				11	1
Five townships	32				32	
SHERBURNE COUNTY—						
Clear Lake, village	2				2	
One township	10				10	
SIBLEY COUNTY—						
Arlington, village	3				3	
Gaylord, village		1			1	1
Green Isle, village	1	1			2	1
Henderson, village	9				9	
New Auburn, village				10	10	
Six townships	22	4		1	27	4
STEARNS COUNTY—						
Melrose, village		2			2	2
St. Cloud, city	83		28		111	4
Sauk Centre, city			1		1	
Torah, village	4				4	
Four townships	9		5		14	2
STEELE COUNTY—						
Owatonna, city	2		2		4	1
Two townships	2				2	
STEVENS COUNTY—						
Morris, village	1				1	
One township	14				14	
SWIFT COUNTY—						
Appleton, village			1		1	
Benson, village	3				3	
TODD COUNTY—						
Bertha, village	3				3	
Eagle Bend, village	24				24	
Hewitt, village		2			2	2
Staples, village	1				1	
Three townships	15	1			16	1
TRAVERSE COUNTY—						
Browns Valley, village		1			1	1
Two townships	7				7	
WABASHA COUNTY—						
Lake City, city				5	5	
Plainview, village		2			2	2
Three townships	4				4	
WADENA COUNTY—						
Wadena, village	5		3		8	
Three townships	2		2		4	

TABLE VIII.—Continued.

Locality.	Known Cases Reported by: Health Officers.	Death Returns.	Newspapers.	Physicians.	Total: Cases.	Deaths.
WASECA COUNTY—						
Janesville, village	......	......	4	......	4	......
Waseca, city	2	......	......	......	2	1
Two townships	......	......	1	2	3	......
WASHINGTON COUNTY—						
Forest Lake, village	5	......	......	......	5	......
Stillwater, city	11	......	......	15	26	1
Four townships	9	1	......	1	11	3
WATONWAN COUNTY—						
St. James, city	5	......	......	......	5	......
One township	2	......	......	......	2	......
WILKIN COUNTY—						
One township	......	1	......	......	1	1
WINONA COUNTY—						
Winona, city	161	......	......	......	161	3
Two townships	4	......	......	......	4	......
WRIGHT COUNTY—						
Howard Lake, village	2	......	......	......	2	......
Monticello, village	11	......	......	......	11	......
Waverly, village	9	......	......	......	9	......
Nine townships	42	......	......	......	42	2
YELLOW MEDICINE COUNTY—						
Granite Falls, city	......	......	2	......	2	......
Wood Lake, village	4	......	......	......	4	......
Two townships	7	1	......	......	8	2
Total	3,114	73	126	186	3,499	194

MEASLES.

The conditions as to measles has not changed materially. This is generally looked upon as a harmless disease. It may be well, in order to show its true position, to contrast it with scarlet fever. The deaths as reported to the State Board of Health 1895-1901, inclusive, for these two diseases are as follows:

	Scarlet Fever.	Measles.		Scarlet Fever.	Measles.
1895	108	73	1900	80	54
1896	63	137	1901	75	94
1897	44	28		——	——
1898	47	264	Total (7 years)	468	694
1899	51	44			

It will thus be seen that measles should receive as careful attention as scarlet fever. The above undoubtedly does not represent the total mortality from measles, for, as a rule, deaths which result from the *sequelæ* of measles are not reported as measles. We have such reports given under bronchitis, tuberculosis, etc.

DIPHTHERIA.

In the last biennial report of this board (page 33) reference is made to the fact that there was too much carelessness in dealing with this disease. This fact is demonstrated by the conditions during the past two years. There is a steady increase in the number of cases and in the number of deaths from year to year. As antitoxin came into use the mortality from diphtheria was reduced from about 40 per cent to 10 per cent, but with the rapid disappearance of membrane under the antitoxin came lax quarantine methods. The laity generally and physicians too often seem to consider the disappearance of membrane as an evidence for removal of quarantine, while as a matter of fact it is nothing of the kind. Quarantine is for the protection of the well against infection, not for the purpose of curing disease. The raising of quarantine from diphtheria cases is to be governed by the abatement of danger of infection and not by the *appearance* of a patient's throat. There is only one way to determine when this danger has ceased to exist, and that is by bacteriological findings, and these should be based upon cultures taken from *both nose and throat*, especially the nose, for the bacillus of this disease is apt to persist in the nose for a

longer period than in the throat. The disappearance of membrane from the throat is no evidence of disappearance of the bacillus, as we all know or should know.

Supplementing the above statements, it may be well to know the death rate from diphtheria per thousand deaths from all causes. During the past twelve years it is as follows:

1890	about 67	1896	about 46
1891	" 62	1897	" 28
1892	" 60	1898	" 25
1893	" 51	1899	" 22
1894	" 46	1900	" 34
1895	" 46	1901	" 41

It seems to me that we can justly give antitoxin the credit of gradually reducing the death rate from diphtheria per thousand total deaths from 67 in 1890 to 22 in 1899, and we can justly charge to careless methods in quarantine the increase in mortality from 22 per thousand deaths in 1899 to 41 in 1901.

It is interesting to note where the highest mortality for diph-During the past twelve years it was as follows:

	Cities Over 50,000.	Cities 10,000 to 20,000.	Cities and Villages 5,000 to 10,000.	Small Villages and Rural Districts.
1900	40	11	14	34
1901	50	16	18	38

This little table shows us exactly what we would expect, viz., the best results in villages and cities ranging in population from 5,000 to 20,000; the worst results in large cities and rural districts, and the reasons are quite plain. In large cities diphtheria is practically endemic, due undoubtedly to insufficient quarantine. In country districts the disease is often not recognized early, and hence produces a comparatively high mortality before an epidemic is brought under control, while in the cities and villages of smaller population the disease is not permitted to become endemic as in the larger cities, and is treated more promptly and intelligently from the outset than in country districts.

The record for our three largest cities for the years 1900 and 1901 is as follows:

DEATHS FROM DIPHTHERIA PER 1,000 TOTAL DEATHS.

	*Minneapolis.	St. Paul.	Duluth.
1900	50	34	24
1901	about 70	26	42

Although the death rate of diphtheria per 1,000 deaths from all causes has been going up instead of down during the past few years, the mortality rate is comparatively low—about 14 per cent. This is not as low as it should be, however. There is still plenty of work for antitoxin, isolation hospitals, quarantine and disinfection to do so far as diphtheria is concerned.†

The following table gives a twenty-one months' record of diphtheria in this state, as we have been able to secure it through official and non-official sources:

*Statistics from the United States Department of Labor place Minneapolis in the lead with deaths due to diphtheria, with Lowell (Mass.), Salt Lake City, Des Moines, Camden (N. J.), Hartford, Cleveland, Denver, Boston and Duluth following.—From Journal American Medical Association, Nov. 15, 1902, p. 1265.

† For other data bearing upon diphtheria see Tables I., II., III., and IV also, pages 76-89 inclusivo.

TABLE IX.

Diphtheria Record (Including Croup) from Nov. 1, 1900, to Aug. 1, 1902 (21 Months.)

	Known Cases Reported by					Totals.	
	Health Officer.	Labora-tory.	Death Returns.	News-papers.	Physi-cians.	Cases.	Deaths.
AITKIN COUNTY—							
Aitkin, city	....	1	....	....	....	1	....
Three townships	1	....	1	3	....	5	1
ANOKA COUNTY—							
Anoka, city	1	4	2	2	4	13	2
Seven townships	29	....	7	3	4	43	16
BECKER COUNTY—							
Detroit, city	....	7	3	3	....	13	3
Frazee, village	4	1	1	....	....	6	1
Lake Park, village	2	2	....	....	....	4	....
Thirteen townships	31	11	8	....	....	50	16
BELTRAMI COUNTY—							
Bagley, village	1	....	....	....	....	1	....
Bemidji, village	10	10	....	2	2	24	2
Black Duck, village	....	....	....	2	....	2	....
Solway, village	6	....	....	1	....	7	....
Seven townships	11	2	3	....	3	19	5
BENTON COUNTY—							
Foley, village	....	....	....	....	4	4	....
Ronneby, village	1	....	....	4	....	5	....
Sauk Rapids, village	....	....	1	....	....	1	1
Six townships	17	....	1	....	9	27	1
BIG STONE COUNTY—							
Beardsley, village	8	2	....	....	....	10	....
Clinton, village	....	....	2	....	....	2	2
Graceville, village	1	4	2	1	....	8	2
Ortonville, city	....	....	1	....	1	2	1
One township	2	....	....	....	....	2	....
BLUE EARTH COUNTY—							
Amboy, village	....	....	1	....	....	1	1
Garden City, village	....	....	....	1	....	1	....
Lake Crystal, village	....	2	....	....	....	2	....
Madison Lake, village	....	2	....	....	....	2	....
Mankato, city	81	17	....	6	2	106	8
Mapleton, village	....	....	....	1	....	1	1
Vernon Centre, village	....	....	1	....	....	1	1
Eight townships	25	....	5	....	....	30	8
BROWN COUNTY—							
Hanska, village	....	1	....	....	....	1	....
New Ulm, city	3	....	....	....	....	3	....
Sleepy Eye, village	....	....	1	6	....	7	1
Springfield, village	....	....	1	2	....	3	1
Five townships	15	....	2	1	2	20	3
CARLTON COUNTY—							
Barnum, village	....	....	....	1	....	1	....
Carlton, village	....	....	1	....	....	1	1
Cloquet, village	1	....	9	1	....	11	9
Moose Lake, village	14	....	....	1	....	15	2
Five townships	14	....	3	....	....	17	6
CARVER COUNTY—							
Chaska, city	....	....	2	....	....	2	2
Cologne, village	....	1	....	....	....	1	....
Norwood, village	....	....	1	....	....	1	1
Six townships	9	1	1	2	1	14	2
CASS COUNTY—							
Walker, village	3	4	....	....	....	7	....
Unorganized townships	....	....	5	....	....	5	5
CHIPPEWA COUNTY—							
Clara City, village	....	1	....	3	....	4	....
Montevideo, village	....	3	....	1	....	4	....
Four townships	3	....	5	....	....	8	5
CHISAGO COUNTY—							
Lindstrom, village	4	1	....	....	....	5	....
North Branch, village	1	1	....	....	....	2	....
Rush City, village	1	2	....	....	....	3	....
Four townships	6	7	4	1	....	18	10

TABLE IX.—Continued.

	Known Cases Reported by					Totals.	
	Health Officer.	Laboratory.	Death Returns.	Newspapers.	Physicians.	Cases.	Deaths.
CLAY COUNTY—							
Barnesville, city	.....	2	2	7	.....	11	2
Glyndon, village	6	.....	.....	.....	.....	6	1
Hawley, village	.....	3	.....	.....	.....	3	.....
Moorhead, city	.....	5	8	7	.....	20	8
Ulen, village	.....	.....	.....	1	.....	1	.....
Fifteen townships	34	8	6	16	.....	64	13
COOK COUNTY—							
One township	.....	.....	2	.....	.....	2	2
COTTONWOOD COUNTY—							
Bingham Lake, village	.....	1	.....	.....	.....	1	.....
Jeffries, village	.....	1	.....	.....	.....	1	.....
Mountain Lake, village	7	7	.....	14	.....	28	3
Windom, village	2	2	.....	.....	.....	4	.....
Eight townships	14	.....	11	4	.....	29	14
CROW WING COUNTY—							
Brainerd, city	111	15	1	4	4	135	8
Six townships	1	.....	7	1	.....	9	7
DAKOTA COUNTY—							
Farmington, village	5	9	.....	2	2	18	2
Hastings, city	6	4	.....	.....	.....	10	1
Lakeville, village	4	3	.....	1	.....	8	.....
Lilydale, village	2	.....	.....	.....	.....	2	.....
Randolph, village	1	1	.....	.....	.....	2	.....
Rosemount, village	2	.....	.....	.....	.....	2	1
South St. Paul, city	.....	1	2	1	.....	4	2
West St. Paul, city	2	.....	1	.....	.....	3	1
Fifteen townships	38	1	5	7	19	70	9
DODGE COUNTY—							
Claremont, village	1	1	.....	.....	.....	2	1
Dodge Centre, village	.....	2	.....	.....	.....	2	.....
West Concord, village	7	2	1	1	.....	11	2
Three townships	4	.....	1	.....	.....	5	1
DOUGLAS COUNTY—							
Alexandria, city	.....	1	3	.....	.....	4	3
Brandon, village	.....	.....	.....	8	.....	8	.....
Evansville, village	.....	2	.....	.....	.....	2	.....
Osakis, village	.....	.....	.....	3	.....	3	.....
Four townships	1	.....	3	5	.....	9	3
FARIBAULT COUNTY—							
Blue Earth, city	2	8	.....	.....	.....	10	1
Bricelyn, village	.....	.....	.....	1	.....	1	.....
Kiester, village	2	.....	.....	.....	.....	2	1
Winnebago, village	2	.....	.....	.....	.....	2	1
Three townships	6	.....	1	2	.....	9	1
FILLMORE COUNTY—							
Harmony, village	.....	.....	1	.....	.....	1	1
Lanesboro, village	.....	1	.....	.....	.....	1	.....
Preston, village	.....	1	1	.....	.....	2	1
Rushford, city	.....	.....	3	.....	.....	3	.....
Six townships	3	3	.....	5	.....	11	1
FREEBORN COUNTY—							
Albert Lea, city	5	2	.....	.....	.....	7	1
Five townships	4	1	1	1	.....	7	2
GOODHUE COUNTY—							
Cannon Falls, village	8	6	.....	.....	.....	14	.....
Kenyon, village	.....	2	1	.....	.....	3	1
Red Wing, city	7	9	2	.....	.....	18	4
Zumbrota, village	2	.....	.....	1	.....	3	.....
Five townships	1	.....	2	2	.....	5	2
GRANT COUNTY—							
Herman, village	12	.....	.....	.....	.....	12	.....
HENNEPIN COUNTY—							
Edina, village	6	.....	.....	.....	.....	6	3
Hopkins, village	1	9	.....	.....	.....	10	.....
Minneaplis, city	1,226	.....	.....	.....	.....	1,226	113
Osseo, village	2	.....	.....	.....	.....	2	.....
Robbinsdale, village	6	1	.....	.....	.....	7	2
Wayzata, village	1	.....	.....	.....	.....	1	.....
Thirteen townships	26	.....	6	.....	.....	32	8

TABLE IX.—Continued.

	Known Cases Reported by					Totals.	
	Health Officer.	Laboratory.	Death Returns.	Newspapers.	Physicians.	Cases.	Deaths.
HOUSTON COUNTY—							
Caledonia, village	150	5				155	1
Hokah, village	14					14	2
Houston, village		3				3	1
Spring Grove, village	6					6	
Eleven townships	5	18	5		13	41	10
HUBBARD COUNTY—							
Farris, village	1		1			2	2
Park Rapids, village	4	69	5			78	9
Five townships	4	2	5			11	5
ISANTI COUNTY—							
Cambridge, village	5	4				9	
Isanti, village	2	1				3	
Seven townships	7	2	5			14	7
ITASCA COUNTY—							
Deer River, village			2	4		6	2
Grand Rapids, city	16	6		3		25	1
JACKSON COUNTY—							
Heron Lake, village	9	2		3		14	1
Lakefield, village		6				6	
Seven townships	27		2	1		30	6
KANABEC COUNTY—							
Mora, village	1			1		2	
Three townships	8	8				16	1
KANDIYOHI COUNTY—							
Willmar, city		1			1	2	
Three townships	12	2				14	3
KITTSON COUNTY—							
Hallock, village	2	2				4	1
Six townships	8	11	2			21	2
LAC QUI PARLE COUNTY—							
Bellingham, village		5				5	
Dawson, village	1					1	
Madison, village	2	5	1	4		12	3
Marietta, village				2		2	
Nassau, village	1					1	
Six townships	10	2	1			13	2
LAKE COUNTY—							
Two Harbors, village	3	11	1	6		21	4
One township			2			2	2
LE SUEUR COUNTY—							
Elysian, village	1	1		1		3	
Kasota, village	3		2		13	18	6
Kilkenny, village			1			1	1
Le Sueur, city		24	1	6		31	1
Le Sueur Centre, village	1					1	
Ottawa, village	1					1	
Ten townships	21	9	4	5	4	43	6
LYON COUNTY—							
Ghent, village	1	2				3	
Marshall, village	1	1				2	1
Taunton, village			1			1	1
Tracy, city	16	4				20	1
One township	3					3	1
McLEOD COUNTY—							
Glencoe, village			1			1	1
Hutchinson, city			2	5	12	19	2
Stewart, village	1			1		2	
Winsted, village	2				3	5	
Nine townships	8	2	6	4	23	43	7
MARSHALL COUNTY—							
Argyle, village	5					5	
Stephen, village	3	4				7	1
Warren, city	4					4	
Ten townships	26	7	4			37	11
MARTIN COUNTY—							
Fairmont, village	1	4		1		6	
Five townships	8		1			9	2

TABLE IX.—Continued.

	Known Cases Reported by					Totals.	
	Health Officer.	Laboratory.	Death Returns.	Newspapers.	Physicians.	Cases.	Deaths.
MEEKER COUNTY—							
Dassel, village	.....	.....	.....	1	.....	1	.....
Eden Valley, village	1	.....	.....	1	.....	2	1
Forest City, village	.....	.....	.....	1	.....	1	.....
Grove City, village	2	1	.....	.....	.....	3	1
Litchfield, city	2	1	.....	.....	.....	3	.....
Watkins, village	2	8	.....	.....	.....	10	.....
Eight townships	49	1	3	2	.....	55	10
MILLE LACS COUNTY—							
Milaca, village	.....	1	.....	.....	.....	1	.....
Princeton, village	.....	.....	.....	3	.....	3	.....
Two townships	1	.....	1	.....	.....	2	1
MORRISON COUNTY—							
Little Falls, city	2	.....	1	11	.....	14	3
Pierz, village	.....	.....	2	1	.....	3	2
Eight townships	15	.....	5	2	.....	22	9
MOWER COUNTY—							
Austin, city	.....	6	.....	.....	.....	6	1
Dexter, village	4	2	.....	.....	.....	6	.....
Eight townships	24	1	2	.....	.....	27	4
MURRAY COUNTY—							
Four townships	4	1	2	.....	.....	7	2
NICOLLET COUNTY—							
Nicollet, village	.....	.....	1	.....	.....	1	1
North Mankato, village	.....	.....	3	.....	2	5	3
St. Peter, city	3	.....	.....	.....	.....	3	1
Four townships	4	.....	1	2	.....	7	2
NOBLES COUNTY—							
Adrian, village	5	5	.....	2	.....	12	.....
Bigelow, village	1	.....	.....	.....	.....	1	.....
Brewster, village	1	.....	.....	.....	.....	1	.....
Kinbrae, village	.....	.....	1	.....	.....	1	1
Worthington, village	2	3	.....	1	1	7	1
Six townships	2	1	3	.....	.....	6	4
NORMAN COUNTY—							
Ada, village	4	2	.....	.....	.....	6	2
Gary, village	5	2	.....	1	.....	8	.....
Halstad, village	11	.....	.....	3	.....	14	1
Twin Valley, village	.....	4	.....	.....	.....	4	.....
Fourteen townships	33	.....	5	5	8	51	9
OLMSTED COUNTY—							
Rochester, city	5	1	1	.....	.....	7	3
Two townships	1	.....	.....	1	.....	2	.....
OTTER TAIL COUNTY—							
Fergus Falls, city	14	4	.....	3	10	31	.....
New York Mills, village	1	3	2	3	.....	9	2
Pelican Rapids, village	2	.....	.....	2	.....	4	.....
Perham, village	1	2	.....	1	.....	4	.....
Twenty-nine townships	29	4	31	30	25	119	37
PINE COUNTY—							
Hinckley, village	.....	1	.....	.....	.....	1	.....
Pine City, village	.....	4	.....	.....	.....	4	.....
Sandstone, village	.....	3	1	.....	.....	4	1
Eight townships	11	1	12	5	.....	29	14
PIPESTONE COUNTY—							
Holland, village	.....	4	.....	.....	.....	4	.....
Pipestone, city	.....	11	1	2	.....	14	1
Trosky, village	.....	2	.....	.....	.....	2	.....
Three townships	8	.....	1	.....	.....	9	2
POLK COUNTY—							
Crookston, city	.....	.....	2	4	.....	6	2
East Grand Forks, city	16	.....	2	1	.....	19	6
Fertile, village	3	6	.....	.....	.....	9	.....
Fosston, village	.....	2	.....	.....	.....	2	.....
Fifteen townships	7	1	7	10	.....	25	7
POPE COUNTY—							
Starbuck, village	.....	2	.....	1	2	5	1
Four townships	2	.....	2	1	.....	5	3

TABLE IX.—Continued.

	Known Cases Reported by					Totals.	
	Health Officer.	Labora. tory.	Death Returns.	News-papers.	Physi-cians.	Cases.	Deaths.
RAMSEY COUNTY—							
New Brighton, village	1	.....	1	.....	.....	2	1
North St. Paul, village	.....	.....	1	.....	.....	1	1
St. Paul, city	1,237	.....	.....	.....	.....	1,237	118
White Bear, village	.....	5	.....	.....	.....	5	.....
Two townships	16	.....	.....	.....	.....	16	3
RED LAKE COUNTY—							
Red Lake Falls, village	3	.....	.....	.....	.....	3	.....
Thief River Falls, village	4	.....	.....	1	.....	5	.....
Three townships	4	.....	2	.....	.....	6	3
REDWOOD COUNTY—							
Belview, village	2	2	.....	.....	.....	4	.....
Morgan, village	1	.....	.....	.....	.....	1	.....
Redwood Falls, city	8	11	.....	.....	1	20	3
Walnut Grove, village	.....	.....	1	.....	.....	1	1
Seven townships	12	3	3	.....	.....	18	6
RENVILLE COUNTY—							
Buffalo Lake, village	1	.....	.....	1	.....	2	.....
Franklin, village	.....	.....	.....	.....	4	4	.....
Morton, village	1	.....	.....	.....	.....	1	.....
Sacred Heart, village	5	.....	.....	.....	.....	5	1
Seven townships	8	.....	3	.....	3	14	4
RICE COUNTY—							
Dundas, village	1	.....	.....	.....	5	6	1
Faribault, city	24	4	.....	.....	.....	28	3
Nerstrand, village	1	.....	.....	.....	.....	1	.....
Northfield, city	2	1	3	.....	7	13	5
Veseli, village	1	.....	.....	.....	.....	1	.....
Ten townships	28	1	3	1	1	34	10
ROCK COUNTY—							
Hardwick, village	.....	.....	.....	1	.....	1	.....
Luverne, village	.....	.....	.....	1	.....	1	.....
Four townships	4	6	1	.....	.....	11	2
ROSEAU COUNTY—							
Roseau, village	21	.....	.....	.....	.....	21	1
Six townships	42	.....	6	2	.....	50	16
St. LOUIS COUNTY—							
Biwabik, village	.....	13	.....	.....	.....	13	.....
Duluth, city	233	.....	.....	.....	.....	233	35
Ely, city	5	.....	8	2	.....	15	9
Eveleth, city	4	2	.....	.....	.....	6	.....
Floodwood, village	11	.....	.....	.....	.....	11	.....
Hibbing, village	.....	.....	1	7	.....	8	1
McKinley, village	7	2	.....	.....	.....	9	.....
Mountain Iron, village	2	.....	.....	.....	.....	2	1
Proctor Knott, village	.....	.....	1	.....	.....	1	1
Tower, city	8	2	.....	1	.....	11	.....
Virginia, city	.....	5	.....	.....	5	10	.....
Seven townships	17	14	6	.....	.....	37	8
SCOTT COUNTY—							
New Market, village	2	1	.....	.....	.....	3	.....
Shakopee, city	.....	.....	3	1	.....	4	3
Seven townships	14	1	1	.....	.....	16	3
SHERBURNE COUNTY—							
Clear Lake, village	1	1	.....	2	.....	4	.....
Elk River, village	2	1	.....	.....	.....	3	.....
Five townships	23	.....	2	.....	1	26	8
SIBLEY COUNTY—							
Green Isle, village	.....	.....	2	.....	.....	2	2
Four townships	22	.....	2	1	.....	25	5
STEARNS COUNTY—							
Belgrade, village	.....	5	.....	2	.....	7	1
Kimball Prairie, village	.....	3	.....	5	.....	8	.....
Melrose, village	.....	.....	2	1	.....	3	2
New Paynesville, village	.....	1	.....	.....	.....	1	.....
Paynesville, village	.....	.....	1	.....	1	2	1
St. Cloud, city	20	6	1	3	.....	30	4
Sauk Centre, city	9	.....	.....	.....	.....	9	3
Waite Park, village	1	.....	.....	1	.....	2	.....
Nineteen townships	38	3	9	7	2	59	13
STEELE COUNTY—							
Blooming Prairie, village	.....	1	.....	.....	.....	1	.....
Owatonna, city	2	18	.....	.....	.....	20	2
Four townships	4	.....	1	1	4	10	5

TABLE IX.—Continued,

	Known Cases Reported by					Totals.	
	Health Officer.	Laboratory	Death Returns.	Newspapers.	Physicians.	Cases.	Deaths.
STEVENS COUNTY—							
Chokio, village	4	3	.....	.....	.....	7	1
Morris, village	2	6	.....	.....	.....	8	1
Five townships	6	1	1	4	.....	12	1
SWIFT COUNTY—							
Appleton, village	1	.....	.....	.....	.....	1	.....
Benson, village	2	3	.....	.....	.....	5	.....
Three townships	5	.....	1	.....	.....	6	2
TODD COUNTY—							
Bertha, village	1	.....	.....	.....	.....	1	.....
Browerville, village	2	3	2	2	.....	9	3
Eagle Bend, village	3	1	.....	.....	.....	4	.....
Long Prairie, village	.....	1	.....	3	.....	4	.....
Staples, village	4	.....	.....	.....	.....	4	.....
Seven townships	7	2	2	4	.....	15	2
TRAVERSE COUNTY—							
Browns Valley, village	1	.....	.....	.....	.....	1	.....
Wheaton, village	4	.....	.....	.....	.....	4	1
One township	5	.....	.....	.....	.....	5	.....
WABASHA COUNTY—							
Elgin, village	.....	1	.....	.....	.....	1	.....
Lake City, city	10	2	1	.....	.....	13	2
Minnieska, village	.....	.....	4	.....	.....	4	4
Four townships	7	1	.....	.....	.....	8	1
WADENA COUNTY—							
Verndale, village	3	9	.....	.....	.....	12	.....
Wadena, village	5	12	1	1	.....	19	2
WASECA COUNTY—							
Janesville, village	.....	.....	.....	1	.....	1	.....
Waseca, city	1	.....	.....	.....	.....	1	1
One township	.....	.....	.....	1	.....	1	.....
WASHINGTON COUNTY—							
Forest Lake, village	1	.....	.....	.....	.....	1	.....
Marine, village	.....	1	1	.....	.....	2	1
Newport, village	1	.....	.....	.....	.....	1	1
Stillwater, city	70	22	.....	2	11	105	12
South Stillwater, village	.....	6	2	.....	.....	8	2
Seven townships	27	2	9	.....	3	41	12
WATONWAN COUNTY—							
Butterfield, village	1	1	.....	2	.....	4	.....
Madelia, village	.....	1	.....	1	.....	2	.....
St. James, city	6	.....	.....	.....	.....	6	1
Six townships	11	.....	.....	.....	4	15	6
WILKIN COUNTY—							
Breckenridge, village	3	.....	.....	3	.....	6	1
Rothsay, village	3	2	.....	.....	.....	5	.....
Six townships	15	.....	7	.....	.....	22	7
WINONA COUNTY—							
Elba, village	16	.....	.....	.....	.....	16	2
Lewiston, village	.....	1	.....	.....	.....	1	.....
St. Charles, city	.....	.....	.....	1	.....	1	.....
Winona, city	84	.....	.....	.....	.....	84	5
Nine townships	9	4	5	5	.....	23	8
WRIGHT COUNTY—							
Buffalo, village	2	2	.....	2	.....	6	.....
Clearwater, village	.....	2	.....	1	.....	3	.....
Cokato, village	2	.....	.....	.....	.....	2	.....
Delano, village	.....	2	.....	.....	.....	2	.....
Howard Lake, village	3	19	.....	2	.....	24	.....
Monticello, village	7	3	.....	.....	.....	10	.....
St. Michaels, village	.....	1	.....	.....	.....	1	.....
Waverly, village	.....	1	.....	.....	.....	1	.....
Eighteen townships	73	8	13	3	4	101	31
YELLOW MEDICINE COUNTY—							
Canby, village	2	.....	.....	.....	.....	2	.....
Clarkfield, village	1	.....	.....	.....	.....	1	1
Echo, village	.....	1	.....	1	.....	2	.....
Granite Falls, city	1	8	.....	1	.....	10	.....
Hanley Falls, village	1	.....	.....	.....	.....	1	1
Wood Lake, village	1	.....	3	4	.....	8	3
Two townships	3	.....	2	3	.....	8	3
Totals	4,824	758	410	377	230	6,599	995

TYPHOID FEVER.

This is not a quarantinable disease, hence the morbidity statistics bearing upon it are quite imperfect. It is a filth disease, hence all communities where it exists should try to locate its immediate source and remove it.

The State Board of Health is indebted to the general practitioner throughout the state for much of the information embodied in the following table (X.), and it is truly thankful for the assistance that has been so generously given. Typhoid fever is quite generally looked upon as a city disease, but this table (X.) seems to indicate that it is everywhere. The following summary is worthy of note:

	Cases.	Deaths.	Death Rate.
1. Cities and villages............	1.195	302	25 per cent.
2. Small villages	348	92	26 per cent.
3. Country districts	599	261	44 per cent.

The percentage of death rate, as shown above, is entirely too high for all districts recorded, and we can draw but one conclusion therefrom, viz., that the cases reported are far below the actual facts. This is especially true for the country districts. The mortality from typhoid fever in Minnesota is not high. If we assume that it is ten per cent we should then have the actual cases of typhoid fever for the above three divisions somewhat as follows:

Cities and villages..	3.020 cases.
Small villages	920 cases.
Country districts	2,610 cases,

Or a total of 6,550 cases in the state during the twenty-one months.

This is probably below the actual condition. It is a fact that many of the cases that appear in the table against cities and villages are imported cases. Bearing this in mind, the number of cases from the rural districts and small villages is still further increased.

Typhoid fever is largely a water borne disease. But one conclusion can be drawn from this report, viz., that the drinking water supplies throughout the state need more rigid sanitary supervision, and this is as true of the farm well as of the city supplies. It is worthy of note that the water supply of St. Paul is a comparatively safe one; that the conditions at Duluth have been decidedly changed during the past few years, for, with the change in the

source, a city in which typhoid was epidemic has been changed to one in which there are practically no cases in the district dependent upon the public water supply. In this connection I wish to draw your attention to the paper on typhoid fever by Dr. J. M. Robinson, on page 10 of this report. It is hardly necessary to refer to Minneapolis as one of the cities with a very faulty water supply, for the fact is already well known. I wish, however, to draw your attention to certain places where typhoid fever has prevailed to quite an extent, and at the same time would ask you to note the reports from our chemical and bacteriological laboratories upon their drinking waters. I refer to Detroit, Bemidji, Montevideo, Brainerd, Two Harbors, Hutchinson, Fairmont, Little Falls, Worthington, Fergus Falls, Crookston, Ely, Eveleth, Hibbing, Virginia, St. Cloud, Owatonna, Stillwater, Winona and others.

If there is any one preventable disease that is a disgrace to a community it is typhoid fever. Its existence is an evidence of negligence and filth on the part of the place involved.

TABLE X.

Typhoid Fever Record, Minnesota, Nov. 1, 1900, to Aug. 1, 1902 (21 Months).

Name of County.	Cities and Villages Over 2,000 Inhabitants.			Small Cities and Villages.			Country Districts.		
	Place.	Cases.	Deaths.	Place.	Cases.	Deaths.	Place.	Cases.	Deaths.
Aitkin				Aitkin	7		2 T'wnships	3	2
Anoka	Anoka	3					4 "	5	2
Becker	Detroit	10	6	Frazee	6		9 "	12	9
"				Lake Park	1				
Beltrami	Bemidji	17	7	Bagley	1		3 "	4	3
"				Farley	1	1			
Benton				Foley	2		7 "	13	7
"				Ronneby	2				
"				Sauk Rapids	3	1			
Big Stone				Graceville	2	1	2 "	4	1
"				Ortonville	15				
Blue Earth	Mankato	7	4	G. Thunder.	3	1	2 "	3	
"				Mad'n Lake	2				
Brown	New Ulm	6	1	Springfield	2	1	1 "	1	1
"	Sleepy Eye.	3							
Carlton	Cloquet	3	3	Barnum	2	1	5 "	8	6
"				Carlton	1	1			
"				Thomson	1				
Carver	Chaska	3	1	Waconia	1		3 "	3	1
Cass	Cass Lake	3		Pillager	1		1 "	2	
"				Walker	2				
Chippewa	Montevideo	10		Granite F.	1	1	4 "	9	3
"				Milan	7				
Chisago				Lindstrom	2		4 "	6	6
"				Rush City	1	1			
Clay	Moorhead	20	9	Barnesville	2	1	7 "	10	6
Cottonwood				Westbrook	1		4 "	12	4
"				Windom	1				
Cook				G. Marais	1				
Crow Wing	Brainerd	29	11				6 "	13	9
Dakota	Hastings	5	1	F'rmi'gton	1		2 "	2	2
"	W. St. Paul.	1	1						
Dodge				W. Concord.	1		2 "	2	2
Douglas	Alexandria	8	5				7 "	8	8
Faribault	Wells	9		Elmore	1		2 "	3	3
"	Winnebago	2	2						
Fillmore				Chatfield	1		5 "	5	4
"				Lanesboro	4				
"				Spring Val.	4	1			
"				Wykoff	2				
Freeborn				Glenville	1	1	3 "	7	1
Goodhue	Red Wing	5	4	Can. Falls	1		7 "	8	4
"				Kenyon	6				
"				Pine Island.	2				
Grant				Elbow Lake.	1		1 "	1	1
"				Herman	2				
Hennepin	Minneapolis	248	65	Hopkins	1		2 "	2	2
"				Maple Plain.	1				
"				Osseo	1	1			
"				St. L. Park.	1				
Houston							4 "	8	4
Hubbard				Farris	1		6 "	10	8
"				Hubbard	1				
"				Park Rapids	9	2			
Isanti				Cambridge	4	2	2 "	2	2
Itasca							1 "	2	2
Jackson	Jackson	2	2	Heron Lake.	2		5 "	7	5
"				Lakefield	10	2			
Kanabec				Mora	5	1	1 "	1	1
Kandiyohi	Willmar	3	3	Raymond	1		4 "	4	1
Kittson				Hallock	1		1 "	1	1
"				St. Vincent.	4	3			
Lac qui Parle				Dawson	2	1	2 "	4	1
"				Madison	1	1			
Lake	Two Har.	6	4						

TABLE X.—Continued.

Name of County.	Cities and Villages Over 2,000 Inhabitants.			Small Cities and Villages.			Country Districts.		
	Place.	Cases.	Deaths.	Place.	Cases.	Deaths.	Place.	Cases.	Deaths.
Le Sueur	Le Sueur	6		Kasota	1		1 “	1	1
“				Waterville	2	2			
Lincoln				Hendricks	3		2 “	15	1
“				Lake Bent'n	1				
Lyon	Marshall	6	1	Cottonwood	3	2	4 “	13	5
“	Tracy	4	1						
McLeod	Hutchinson	21	4	Brownton	1		5 “	9	2
“				Winsted	1				
Marshall				Warren	1		8 “	17	8
Martin	Fairmont	13	1	Ceylon	1		7 “	11	1
“				Sherburn	2	1			
Meeker	Litchfield	7	1	Eden Valley	1		7 “	14	3
“				Grove City	1				
“				Watkins	2				
Mille Lacs				Milaca	4	2	2 “	2	1
“				Princeton	2				
Morrison	Little Falls	21	8	Royalton	2	2	5 “	8	4
Mower	Austin	4					2 “	7	1
Murray				Lake Wilson	1				
“				Slayton	1				
Nicollet	St. Peter	10	4				2 “	7	1
Nobles	W'rthingt'n	10	1	Dundee	1		4 “	10	6
“				Ellsworth	1	1			
“				Kinbrae	1	1			
Norman				Ada	2	1	5 “	6	5
“				Gary	2				
“				Twin Valley	1				
Olmsted	Rochester	5	2	Stew'rtville	1		1 “	1	
Otter Tail	Fergus F'lls	44	2	Henning	1		28 “	58	20
“				N. Y. Mills	3				
“				Parkers P.	1				
“				Perham	10	1			
“				Vining	1				
Pine				Pine City	1		3 “	5	4
“				Sandstone	3	1			
Pipestone	Pipestone	5	2	Jasper	1		2 “	2	2
“				Woodstock	1				
Polk	Crookston	16	5				10 “	23	11
Pope				Glenwood	1		3 “	3	1
“				Starbuck	2	2			
Ramsey	St. Paul	104	35	N. Brighton	1	1			
Red Lake	Red L. Falls	5	4	St. Hilaire	2	2	1 “	2	2
“	Thief R. F.	1							
Redwood				Lamberton	1		7 “	17	2
“				Morgan	3				
“				Revere	3				
“				Redwood F.	3				
“				Sanborn	3				
Renville				Bird Island	7		5 “	20	4
“				Hector	2	1			
“				Morton	1				
“				Renville	2				
Rice	Faribault	8	3				2 “	3	2
“	Northfield	3							
Rock	Luverne	3		Hills	1				
Roseau							1 “	1	1
St. Louis	Duluth	236	47	Biwabik	5	3	8 “	16	9
“	Ely	5	4	Buhl	1	1			
“	Eveleth	7	7	McKinley	1	1			
“	Hibbing	7	5	Proctor K.	1				
“	Virginia	7	1	Sparta	2	2			
“				Tower	6	2			
“				W. Duluth	3				
Scott	Shakopee	1		Belle Plaine	1	1	3 “	3	3
“				Jordan	1				
Sherburne				Clear Lake	2		2 “	2	1
Sibley				Winthrop	1	1	7 “	13	

TABLE X.—Continued.

NAME OF COUNTY.	Cities and Villages Over 2,000 Inhabitants. Place.	Cases.	Deaths.	Small Cities and Villages. Place.	Cases.	Deaths.	Country Villages. Place.	Cases.	Deaths.
Stearns........	St. Cloud...	154	12	Belgrade ...	3	1	13 "	23	8
"	Sauk Centre	9	2	Cold Sp'gs..	1	1	....	.....	.....
"	....	.....	.....	Kim. Prairie	2	.....	....	.....	.....
"	....	.....	.....	Melrose	2	.....	....	.....	.....
"	....	.....	.....	N. Paynesville	4	.....	....	.....	.....
"	....	.....	.....	Payn'sville .	1	1	....	.....	.....
"	....	.....	.....	Richmond ..	1	.....	....	.....	.....
"	....	.....	.....	St. Joseph..	2	2	....	.....	.....
Steele.........	Owatonna .	34	6	....	.....	.....	7 "	8	3
Stevens........	Morris	3	.....	....	.....	.....	3 "	3	3
Swift..........	....	.....	.....	Benson	1	.....	4 "	6	6
"	....	.....	.....	Kerkhoven.	1	1	....	.....	.....
"	....	.....	.....	Murdock ...	5	3	....	.....	.....
Todd..........	....	.....	.....	Eagle Bend.	2	1	7 "	12	5
"	....	.....	.....	Long Prairie	1	.....	....	.....	.....
"	....	.....	.....	Staples	1	.....	....	.....	.....
Wabasha......	Lake City..	6	1	Millville ...	1	1	3 "	20	1
"	Wabasha ...	1	.....	....	.....	.....	....	.....	.....
Wadena.......	....	.....	.....	Menahga ..	1	.....	5 "	10	1
"	....	.....	.....	Wadena	18	4	....	.....	.....
Waseca.......	Waseca	6	3	N. Richland.	1	.....	3 "	4	2
Washington...	Stillwater ..	7	2	S. Stillwater	1	1	....	.....	.....
Watonwan....	St. James...	5	1	....	.....	.....	2 "	4	1
Wilkin........	....	.....	.....	Br'k'nridge	26	15	6 "	11	8
"	....	.....	.....	Rothsay ...	1	.....	....	.....	.....
Winona.......	Winona	8	8	....	.....	.....	5 "	12	2
Wright........	....	.....	.....	Annandale .	1	1	7 "	11	3
"	....	.....	.....	Buffalo	4	1	....	.....	.....
"	....	.....	.....	Cokato	2	.....	....	.....	...
"	....	.....	.....	Delano	2	1	....	.....	.....
"	....	.....	.....	Monticello .	1	1	....	.....	.....
Yellow Med...	....	.....	.....	Canby	1	.....	1 "	1	1
"	....	.....	.....	Echo	1	1	....	.....	.....
Total........	....	1,195	302	....	348	92	....	599	261

LEPROSY.

Since our last biennial report three lepers have died, T. T. H. (No. 46), died March 8, 1901. O. T. (No. 64), died April 12, 1901. O. K. K. (No. 62), committed suicide June 29, 1901. It is not strange under the circumstances that he should have done so for his condition had become most pitiable. He was blind as the result of this disease and had become a public charge. Five new cases (72-76 inclusive) have been added to our records but two of these were dead when knowledge of their cases first came to the board (72 and 74). Case 73, L. O. B., was first reported upon June 14, 1902. His is of the anaestthetic type. Full data bearing upon the case has not yet been secured.

No. 74, G. J. This case although now dead must be added to our records. It is of especial interest through the fact that it is the first (known) American born leper in Minnesota. The history of this, and of two more new cases destroys the old idea that leprosy does not originate in Minnesota. This leper was born in Minnesota, July 11, 1870. Symptoms of the disease first appeared about 1885, and he died May 25, 1898. There is no history of leprosy in his family in this country. An uncle died of leprosy in Norway but had never been seen by this patient. The father of the patient is living and healthy, aged 63 (1902). The mother died during the summer of 1902 of an acute illness. Of seven brothers and sisters two died of diphtheria at the ages of five and seven years, one of whooping cough, and one (this case) of leprosy. Of the three living two are healthy; one is a leper (case 75).

There were lepers living in the neighborhood of this family and it is supposed that the infection in this case may have come from a nurse girl, from one of these leprous families; but she is still living and well. Her family history in this country is as follows: A leprous uncle (single) came to Minnesota from Norway in 1875, and died in 1885, aged about 30. Her mother was married in Norway. She too had leprosy when she came to Minnesota and finally died of this disease, aged about 50 (dates of illness, migration and death not given). She had at least five children for that many are now living and well. The nurse girl to whom is given the credit of possibly conveying infection to case 74 when a babe, is one of these five healthy children.

Case 75. J. J. is a brother of 74. He too is American (Minnesota) born. In all probability the infection was from his brother. This patient was born Aug. 19, 1879. His first symptoms of leprosy

are said to have appeared about 1889. He is in fairly good condition and able to work upon his father's farm.

Case 76, E. has not been reported to the board yet, but the facts at hand are as follows: American born, male, aged about 18 years. I think he is the son of a leper, but this is not yet fully established.

At the present time there are fifteen known lepers living in Minnesota, viz:

Cases 33, 37, 48, 53, 55, 56, 57, 61, 63, 65, 68, 69, 73, 75, 76. Seven of these are poor and cared for as public charges.

The report of the committee on "National Leper Homes" prepared for submission to the American Public Health Association at its next meeting may be of interest as showing the conditions prevailing at the present time. It is as follows:

In reporting upon the necessity for the establishment of National Homes for Lepers your committee has deemed it advisable to review the conditions existing in the various countries represented in this Association before finally making its recommendation.

Dr. F. Montizambert, a member of the committee, reports for Canada as follows:

"The only leper home in Canada is the one at Tracadie, N. B., the taking over of which by the Dominion from the Province was one of the terms of the union at the time of confederation. In this lazaretto there are at present (Feb. 22, 1902) eleven male and seven female patients.

"There are also in New Brunswick and in Cape Breton, N. S., three or four known cases of leprosy in the incipient stage, carefully isolated and kept under the observation of the medical superintendent of the Tracadie Lazaretto, but who have not yet been removed to that establishment. There is also what is known as a leper home on D'Arcy Island, B. C. This is not a national home. At the time of my last and unofficial visit last year there were five patients isolated on this island, all Chinamen from the Orient, and each supported by the municipality in British Columbia in which the patient was when the disease was discovered. D'Arcy Island is within easy reach of the city of Victoria, from which supplies are sent from time to time, and the medical care of these patients is under the charge of the health officer of that city. These constitute all the known cases of leprosy in Canada. In Canada lepers are found among the people living on the eastern coast, the Ice-

landers living in Manitoba, and other western provinces, and the Chinese on the Pacific Coast."

Dr. Jesus Chico, a member of the committee, reports from Mexico as follows:

"The Spaniards when they first came to Mexico in 1519 found leprosy to be prevalent in Anahuac, that is, the valley of Mexico and the surrounding high plains. Hernan Cortes, moved by the sight of so many lepers, erected for their benefit a hospital which he christened "Hospital de San Lazero," in which they were isolated and cared for. Nobody at that time was able to tell when this awful disease first appeared in the country, but every well-informed native told the same story: that it was very old; beyond man's memory. Nor could any of the natives give the least idea as to its origin. In pre-Columbian times the Scandinavians who inhabited Iceland and the southern part of Greenland undoubtedly had communication with the Indians of North America, and it is known that leprosy still exists in those islands. Could leprosy have reached Mexico through these Scandinavians infecting the North American Indians, or vice versa? I think the answer must be in the negative. In either case leprosy ought to have been prevalent on the eastern coast of Canada and the United States at the time of their discovery. Of this we have no proof, for neither the French, Dutch nor English explorers give any record of this dreadful disease, which they undoubtedly would have done had they come in contact with it, for it was well-known in Europe, especially after the Crusades. Is it an autochthonous complaint? I do not think so: first, because if it were so it would be dependent to a large extent on conditions as to time and place and could not be, as it is a disease of every climate, of every altitude and of people in every social rank. Shall I venture my own hypothesis as to its origin in Mexico? It must have been imported; and if so, from where? In all probability from the Sandwich Islands. We all know that the disease has prevailed to an awful extent in those islands, and the results of isolation at Molokai are now common knowledge, but it is not well known that those Kanaka people have been among the boldest navigators in the world's history; it is now generally known that the Hawaiian Islanders, paddling in their canoes, went sixty degrees southward from their own islands and settled in New Zealand, where their descendants now live under the name of the Maoris, speaking practically the same language as their ancestors. Bearing this in mind, is it not possible that the Kanaka people visited the western coast of North

America? People who traveled sixty degrees south in their canoes might easily travel twenty-seven degrees northwest to the California coast. California was the cradle for the greater part of the tribes that settled in Anahuac. Reasoning thus there is little wonder that leprosy should have been found so prevalent by Cortes. It may be argued that if the South Sea Islanders came to America it should be possible to trace their descendants among the Mexican people of to-day. As a matter of fact, many people of the Kanaka type can be found in Mexico at the present time. I do not make much of this, for people of many types are to be found in Mexico at the present time.

"So much for the possible origin in Mexico.

"As already stated Cortes founded a hospital for these unfortunates on the shore of the Lake of Texcoco, not far from the City of Mexico. When I was a student this lake had receded to such an extent that the hospital was no longer on an island, but in the midst of a plain. The number of lepers had been so reduced in numbers by this plan of isolation that it was now possible to care for them in a carefully isolated ward at the hospital of San Pablo. Everything points to a decrease in the number of victims of this dread disease in Mexico. In Guanajuato, where I have the best opportunity of knowing what is going on, there certainly is a marked decrease in the number of lepers. No administrative measures are taken against their mingling with the non-leprous, but the public avoids association with them, and in consequence these people voluntarily isolate themselves. Individually I have warned the public from time to time through the local papers as to the dangers attendant upon association with the lepers or residence in a house formerly occupied by a leper. I have also applied to the proper authorities asking that some legal provision be made for the isolation of lepers, and I hope to meet with success in this matter in the near future."

As Cuba was still under the care of the United States Army when I began this report I wrote to Major W. C. Gorgas, then chief sanitary officer of Havana, for information relative to leprosy in that island. He referred me to Major J. B. Kean, then Superintendent of the Department of Charities, Havana, and through this latter official I received a very complete set of reports from Dr. Manuel J. Alfonso, Director of the San Lazero Hospital, at Havana. From these reports it appears that the asylum for lepers (Hospital de San Lazero) was founded in 1681 by a generous Jesuit, D. Pedro Alegre, a Mexican.

The time and manner of introduction of this disease into Cuba is not known. As stated in the report of Dr. Chico for Mexico, the disease was in that country at the time of the first Spanish invasion. The disease was also known to be widespread in Colombia. It could undoubtedly have been introduced into Cuba either from Mexico or from South America. It is also stated that the disease progresses very slowly and has a tendency to disappear. A record of one thousand one hundred and ninety-six cases cared for at this hospital between the years 1830 and 1900 is given as follows:

Whites	568
Blacks	389
Asiatics	199
Mestizos	40
Total	1,196

It appears that in 1895 a law was "ratified" requiring the seclusion of lepers in this asylum, but that the law was not enforced until after the intervention of the United States Government. Prior to that time the lepers resided where they pleased throughout the city, and entered the hospital only when compelled so to do by their "misery." Following the United States control of Havana the police detained all lepers found in the street and placed them in the asylum. This action was often followed by insubordination. Dr. Alfonso states that this infirmity places the patients in such physical condition "that they seem possessed of the spirit of evil." He further states that they are not friends of work, but of vice, and that among them are true criminals.

The San Lazero Hospital is a private institution and possesses considerable property, but not enough for its support. The government, while under the control of the United States, gave considerable aid to this hospital. Whether it had aid from the Spanish government, the report does not state.

Dr. Alfonso gives the following arguments in favor of leprosaria: (1) An opportunity to study doubtful cases; (2) good hygienic surroundings—plenty of bathing, fresh clothing and fresh air: all of which are important adjuncts in the treatment of this disease; (3) provision for the destruction or disinfection of all soiled clothing, bedding and dressings.

It is his opinion that after the diagnosis of leprosy is once made the infected should be compelled by law to enter a leprosarium.

He contends that such a place should not be in the nature of a prison, but rather that everything possible should be done to make the isolation at such an institution endurable.

Dr. C. H. Alden, late assistant surgeon-general, reporting upon Puerto Rico, stated that there were probably a hundred cases of leprosy in that island. Under Spanish rule there had been no attempt at isolation, but under the United States Government, steps had been taken to separate them from people at large, and to furnish them with proper care and treatment.

Among the new possessions of the United States is an island where many lepers have residence, but fortunately under restriction and supervision. I refer to Hawaii.

Under date of April 22, 1902, Dr. J. S. B. Pratt, executive officer of the Territorial Board of Health. informed me that there were 863 lepers at the settlement on Molokai: 519 males, and 344 females. The management of this settlement is directly under the control of the Board of Health.

It is the duty of the various government officials, and other officials, to report the probable presence of leprosy in an individual. Thereupon the suspect is sent to Honolulu to be examined by a board of five medical men, and in order to send the person to Molokai, four out of the five examiners must pronounce the case leprosy. Should three declare the case a leper and two consider it only a suspicious case, then the individual is declared a suspect and is required to report once a month to the government physician of the district in which he lives. If the disease develops later such an individual is sent again to the board of five physicians for re-examination. Specimens are taken from each case for bacteriological examination, and the result of these findings is reported to the examining board before the individual concerned is examined by that body.

The law providing for the segregation of lepers was passed January 3, 1865. It provided for the setting aside of government lands upon which to isolate such leprous persons as should be declared by the Board of Health liable to cause the spread of leprosy. In 1893 the law was passed setting aside the Island of Molokai for the segregation of lepers.

Provision was made that the husband or wife of a leper might be allowed to remain as a helper, or kokua, with such a leper when segregated. Dr. Pratt, in his letter already referred to, speaks of thirty-four male helpers and twenty-eight female helpers on the

island. It is the duty of these helpers or kokuas to prepare the food and attend to the clothing and other things that contribute to the comfort of the lepers, whose kokuas they are.

On this island, lepers may build houses for their own use. They are also allowed to cultivate land and sell their crops. They are not required to pay rent for the land used.

Coming now to the United States proper—the leprosy commission appointed from the Marine Hospital Service, by an act of Congress approved March 2, 1899, "to investigate the origin and prevalence of leprosy in the United States," reports the presence of 278 lepers. The commission states, however, that it "cannot in the nature of things claim to have ascertained the whereabouts of every case of leprosy in the United States." It further states that "many cases are no doubt so mild as to have escaped observation altogether, and many have been purposely hidden." These statements are undoubtedly true, and without doubt some sanitary authorities have taken part in such concealment. I recall the statement of a sanitary official in one of our larger cities to the effect that there were no lepers under his jurisdiction, and that his inspectors would not dare to find one, for should they do so they knew the penalty for reporting such would be discharge from the service. Of the 278 cases reported, only 72 are isolated. More than half of the cases reported are American born. Other peoples are represented as follows: Norwegians 22, Icelanders 11, Swedes 8, Chinese 20, Japanese 1, Germans 12; from the Bahamas 12, Cuba 6, other West Indies 4, Mexico 3, Ireland 6, England 3, France 3, Italy 3, Spain 1. There are other foreign cases, but the nationalities of these had not been given to the commission. The commission reports that "of the states and territories, twenty-one are known to have lepers." The states that have the largest number recorded are Louisiana 155, California 24, Florida 24, Minnesota 20, North Dakota 16.

It has been the general belief that there were no American-born lepers in the northwestern states, where the population is made up largely of Scandinavians and their descendants, but this statement can no longer be maintained, for I now have knowledge of three American-born who contracted leprosy in Minnesota.

There is but one institution in the United States known as a home for lepers, and it is in Louisiana. It has had a somewhat checkered career, and has been maintained under great disadvantages. It has been well described in a recent article by Dr. Isador Dyer.

Carefully studying facts it would appear that provision for the care of lepers in Canada was an inheritance rather than a product of legislation; that the care of lepers in Mexico began with the invasion of Cortes and that the methods of caring for them had been but little if at all improved upon in that country since his time. That provision for the care of the lepers in Cuba was made at an early date by a Jesuit with philanthropic tendencies. Probably little if any improvement was made in the care of these unfortunates from the time of the establishment of the San Lazero Hospital in 1681 up to the occupation of the island by American troups. From personal knowledge I know that the life of the leper in many, if not all, of the other West India Islands is one of existence only. The action taken in Hawaii with regard to the lepers was forced upon the people before the time of American occupancy. It appears that of all the countries embraced in our Association, the United States is the only one that has made no provision for its lepers. At the same time most of the countries that pretend to take care of their leprous have little to boast of.

The commission appointed from the Marine Hospital Service recommends one, or preferably two, national leprosaria for the care of these unfortunates in the United States. It recommends the selection of sites covering broad areas in healthful localities where the lepers can have unlimited out-of-door exercise and occupation. It recommends that these homes should be made attractive and comfortable so that the unfortunate victims of this disease, instead of hiding their condition may make it known and request admission to these public institutions.

With our present knowledge of leprosy in the countries which we represent and the methods employed in its care, it seems to your committee advisable that the resolution adopted by this Association at the Indianapolis meeting in 1900 be reaffirmed, and that the work of pushing legislative action bearing upon this point be referred to our legislative committee.

The resolution referred to reads as follows:

"Whereas, it is a known fact that lepers are found in Canada, the United States and Mexico; that these lepers represent immigrants of many nationalities, together wih some Americans; that the exclusion of leprous immigrants is impossible; that the tendency to importation of leprous immigrants in the future will be greater even than in the past; that the danger of infection of American residents abroad and the importation of the disease through these channels is greatly increased; therefore be it

"Resolved, that this Association places itself on record as favorable to the establishment of national leprosaria, which may serve not only as a refuge for lepers, but also as a home and hospital, making their lives tolerable so far as possible, furnishing employment to those who are able to work, and giving skilled medical care to all cases, with the intent of possibly curing some, and making the road to death less wearisome and painful than it now is, to others."

H. M. BRACKEN,
Chairman.

RABIES.

Two deaths occurred from this disease during the period covered by this report. Other human beings were bitten, but we have no means of knowing the exact number. Some of the bitten individuals went to the Pasteur Institute and attribute their recovery to the treatment there received.

Rabies is entirely too general throughout the state and it will undoubtedly continue until brought under control by the passage of a law requiring a license of *all* dogs in the state and the rigid enforcement of such a law. An excellent paper on rabies by Dr. Sweeney may be found on page 90 of this report. The disease is also fully discussed by the directors of the Bacteriological and of the Veterinary Departments in the reports for their respective departments. It is not necessary therefore to discuss the subject more fully at this time.

ACTINOMYCOSIS.

One death is reported from this disease in 1901. It was that of a man aged twenty-six years, who died May 25, 1901.

ANTHRAX.

One death was recorded from this disease in 1899 which has not as yet ben presented in our biennial reports. The case was that of a man who had been caring for diseased cattle. The case was not brought to the attention of this board in time to make any investigation. There was no spread of the disease.

GLANDERS.

There were two deaths from glanders: one in May, the other in June of 1902; two brothers aged 23 and 26 years. The nature of

the disease was not known in either case until after the death of both patients. Specimens were sent by the attending physician from the second case to the Minnesota State Board of Health Laboratory for examination and the nature of the disease was then fully established. Unfortunately one of the bacteriologists in the laboratory became infected with this same disease while making an investigation of the specimens sent for examination from the fatal case, and has in consequence had a long and serious illness. The final recovery of this case is anxiously hoped for.

The first fatal case above referred to received his infection from his glandered horses. The second case may have had his infection either from the glandered horses or from his brother.

As Dr. Wesbrook will deal fully with these cases in his report for the Bacteriological Department of the Board it is not necessary for me to give the subject further attention. An idea of the amount of glanders among horses throughout the state can be secured from Dr. Brimhall's report for the Veterinary Department of the Board.

TRICHINOSIS.

Five deaths in one family occurred in this state in December, 1900, and January, 1901, from this disease. The history of these cases is as follows:

A family consisting of father, mother and twelve children ate of sausage made from hogs raised on their own farm. The hogs were slaughtered November 28. The family ate of the sausage as early as December 3. The first symptoms of the disease appeared December 19. The disease was first diagnosed as trichinosis by Dr. Beach of Mankato, December 29, when he was first called to see the cases. The first fatal case (daughter, aged 20 years) had been dead ten hours when this physician reached the house. The father (aged 52 years) died January 1. A son (aged 19 years) died January 5, and the fourth and last fatality (the mother, aged 44) occurred January ... The other cases recovered. The source of infection of the hogs was in all probability through rats. These were very numerous about the barn and cribs. The pen in which the hogs were fattened was within ten yards of the corn crib and twenty rods of the barn.

There will be further information upon these cases from Dr. Wesbrook in his report upon the work of the Bacteriological Laboratory.

SLAUGHTER HOUSES.

There has been practically no improvement in the general character or care of slaughter houses throughout the state during the past two years. Rochester, Minn., has been trying for years to secure a model slaughter house. In 1900 an attempt was made to arrange for a municipal abattoir, the building to be constructed by and under the control of the city, the butchers to pay a reasonable rental for the privilege of killing in such place, but this attempt proved a failure through the opposition of some if not all of the butchers of the city. Yet not one of these local butchers has a slaughter house of his own fit to kill animals in for use as food. Of course, with a municipal abattoir properly constructed and cared for it would be possible to secure proper inspection of the meat. It is not long since, with Dr. Adams, the health officer of that city, I visited one of the private slaughter houses. I do not believe that many of the Rochester citizens would buy meat from the shop supplied from this slaughter house had they been with us and seen what we saw of filth and evidence of slaughter of animals not fit for human food.

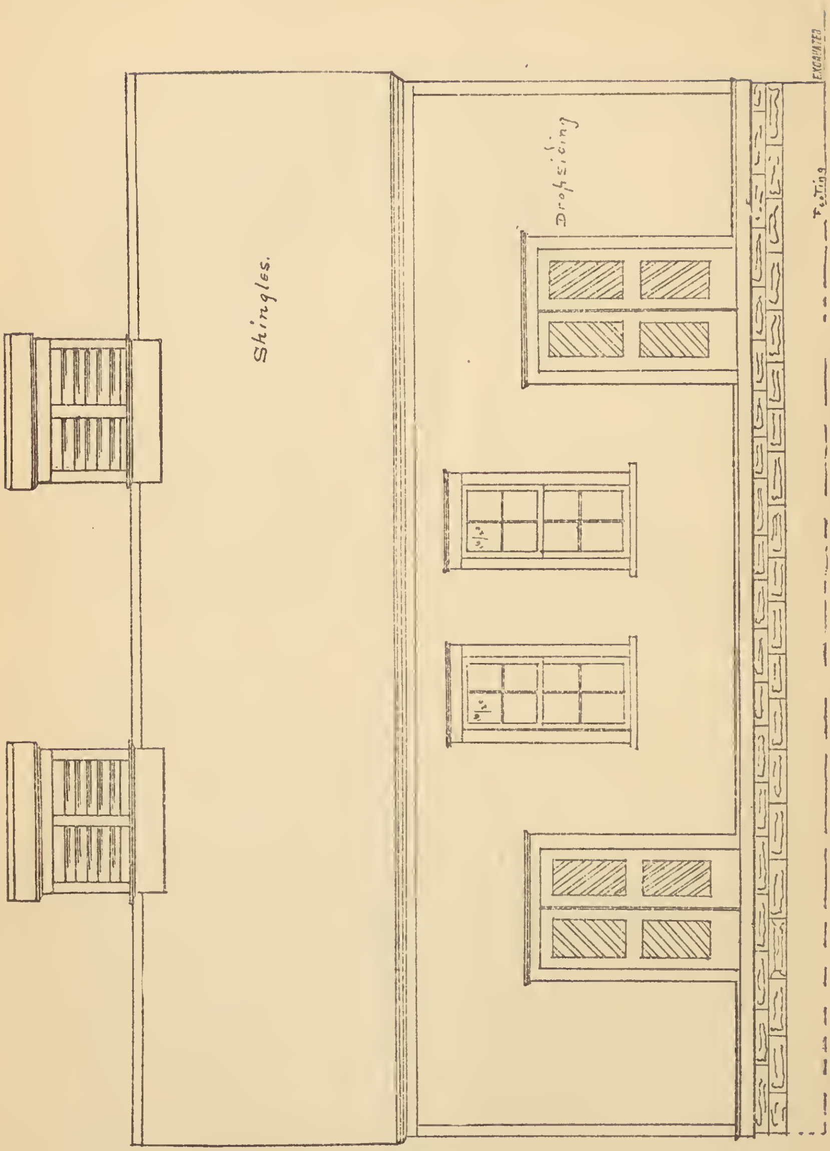
Through the courtesy of Mr. Heffron of Rochester I am able to present the plans that were under consideration for the proposed municipal abattoir. No. 1 gives a general idea of the exterior of the building. No. 2 (A), shows the construction of the walls: a cement wainscoting six feet high with a wooden superstructure. With such wall construction there would be protection from rats and at the same time the greatest opportunities for cleanliness.

No. 3 gives the floor plan of the building, and the scalding tank for hogs. The plans called for a cement floor sloping toward the curved drains encircling in part each killing ring. With sewer connections as shown in the diagram it can readily be seen that no blood or washings would be allowed to accumulate in the slaughtering room.

In No. 4 the scalding vat is shown.

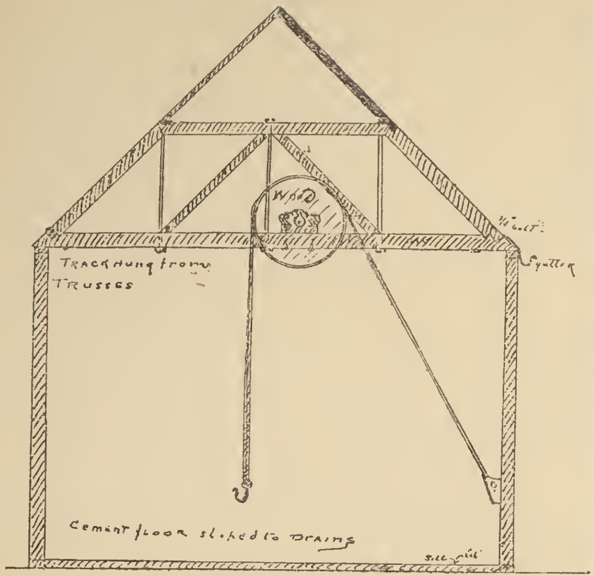
It was the intention of the Rochester authorities to have a cooling room in connection with this abattoir, but such is not shown in these plans.

Such an outfit as the above should be found in every village and city of this state. The first cost should not be heavy and the rental



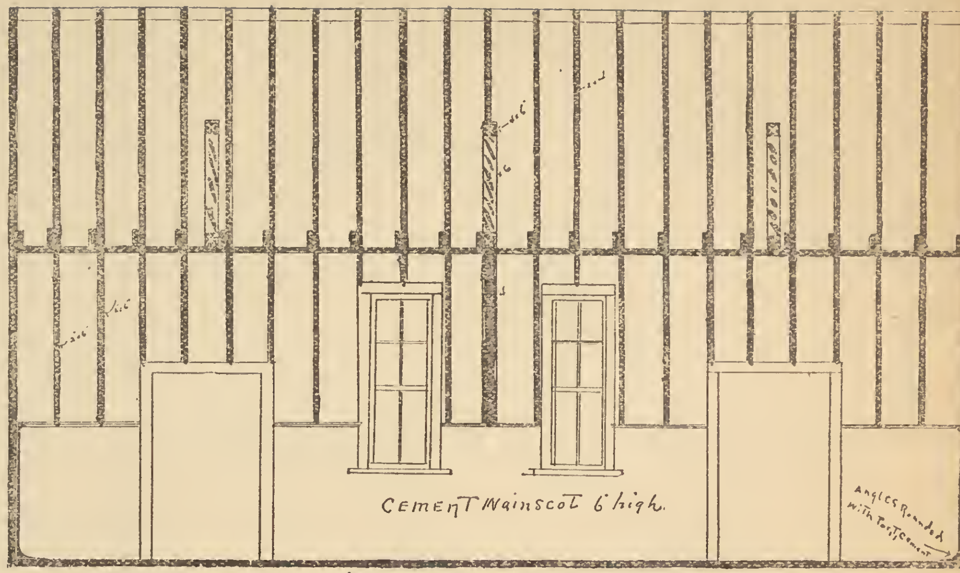
FRONT ELEVATION

No. 1.



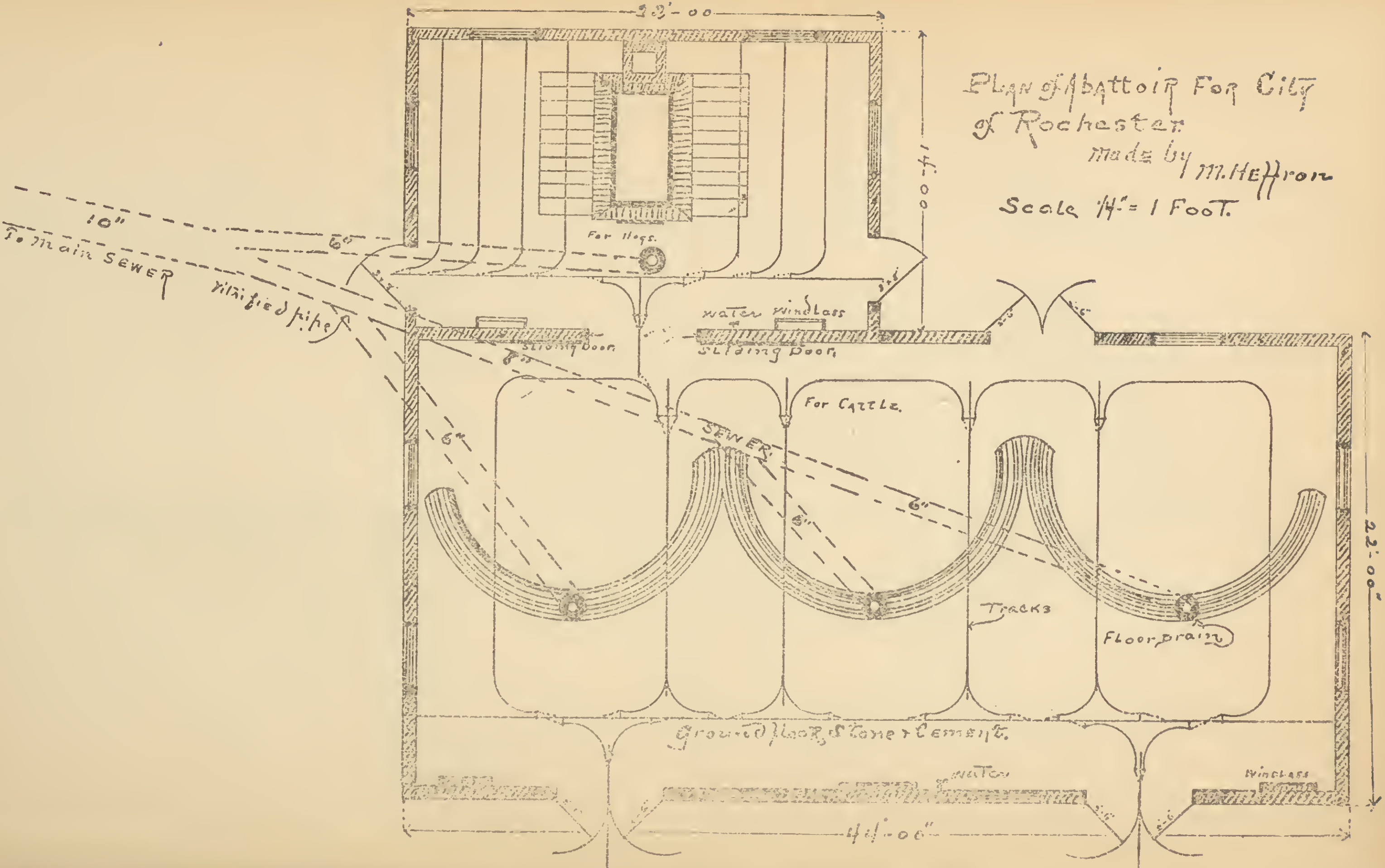
Trasverse section.

No. 2.

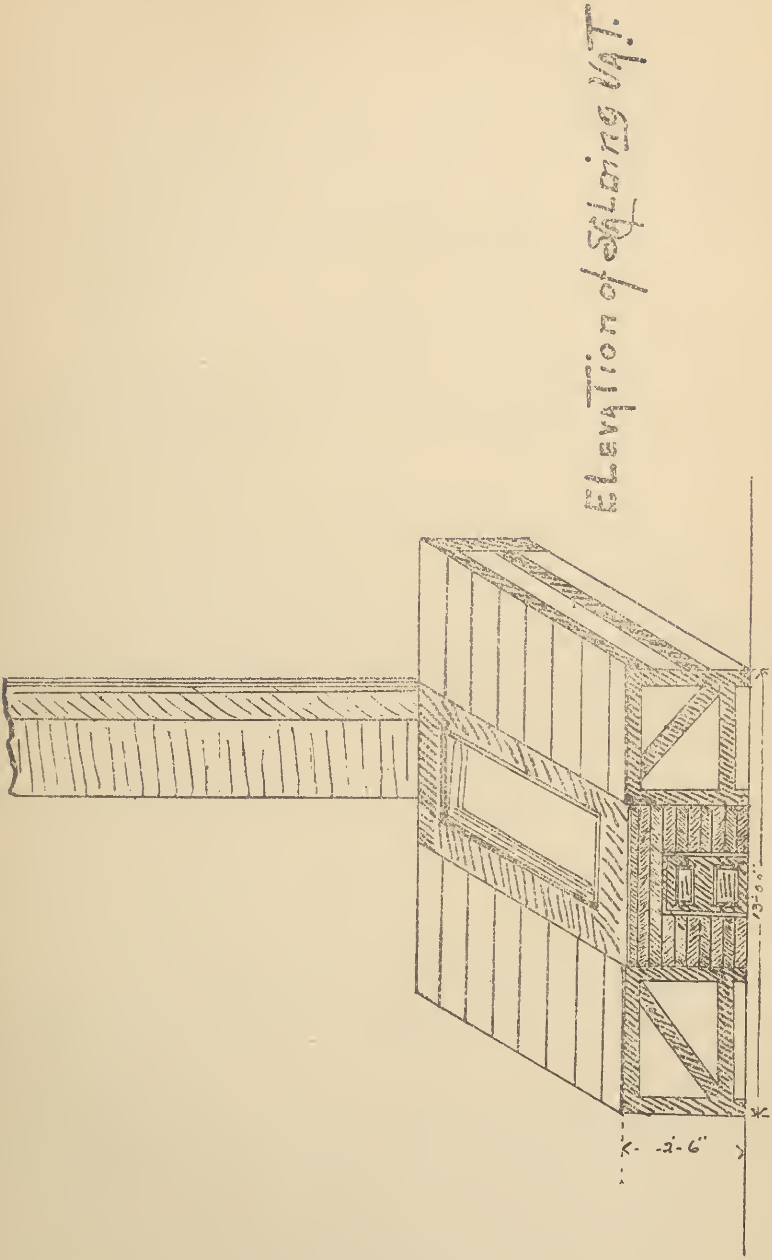


Longitudinal Interior section

No. 2A.


Plan of Abattoir For City of Rochester made by M. Heffron
Scale 1/4" = 1 Foot.
23'-00
14'-00
22'-00"
41'-06"
10"
6"
To main SEWER
Vitrified pipe
For Hogs.
water windlass
Sliding Door
For Cattle.
SEWER
Tracks
Floor Drain
Ground floor, Stone & Cement.
water
windlass

No. 3.



No. 4.

for each butcher should be comparatively small. It is impossible to furnish good meat from the regulation vile country slaughter houses now prevailing, even if the animals slaughtered are of the best. The people who use the meat should see to it that butchers are compelled to provide decent slaughter houses of their own or accept a reasonable municipal proposition. In some places butchers seem to think that it is not necessary for them to be governed by the laws of the state. This was thoroughly illustrated in St. Cloud township in the summer of 1902, when one butcher defied the local authorities in their attempt to clean up his premises. The case was taken into the courts but before a legal settlement had been reached the slaughter house was struct by lightning and burned to the ground. Thus was the nuisance abated and the place disinfected. The town board of supervisors, in order to prevent a repetition of such lawlessness, had the following prepared for them:—

Township of St. Cloud, Stearns Co., July 23, 1902.

By virtue of sections 971-2-3-4 of the General Statutes of the State of Minnesota, for the year 1894, and the various acts and parts of acts amendatory thereof and supplementary thereto, the board of health of the town of St. Cloud, in said county, do hereby make, adopt and publish the following regulations respecting the maintenance and operation of slaughter houses and appurtenant grounds in said town for the purpose of protecting the public health and safety of the inhabitants of said town and preventing the establishment of nuisances therein.

Section 1. No person shall maintain, operate or conduct a slaughter-house within the limits of said town without first obtaining a permit as provided by law.

Sec. 2. All slaughter houses maintained or operated in the said town and the grounds surrounding and appurtenant thereto shall at all times be kept and maintained in a cleanly condition, sanitary and wholesome, and no excrement or other animal product or offal of any kind shall be suffered or allowed to remain or accumulate on or about the same.

Sec. 3. All offal produced by the slaughter house shall be promptly buried or burned after same is made or produced or deposited in some place where the same will not be or become a nuisance or offensive to the inhabitants of said town.

Sec. 4. There shall not be permitted, suffered or allowed in or about any slaughter house or grounds appurtenant thereto any putrid, unsound or decaying hides, beef or pork or meat of any kind or any putrid or decaying carcass or anything whatsoever that is unwholesome or which emits or causes an offensive stench, smell or odor.

Sec. 5. No hogs shall be permitted to be kept or fed in or about any slaughter house, nor shall the offal, blood or excrement from slaughter houses be fed to hogs or any other domestic animal.

Sec. 6. Any person who shall violate any of these regulations shall be deemed guilty of a misdemeanor, and shall be punished by a fine not exceeding One Hundred Dollars ($100) or by imprisonment in the county jail not exceeding three months.

(Signed) JOHN T. MARVIN,
HENRY BRINKMANN,
JOHN L. STREITZ,

As the Board of Health of the Town of St. Cloud, Stearns County, Minn.

It would be well if every township, village and city in the state had similar regulations governing the location and control of slaughter houses.

CREAMERIES.

In the past, complaints have been made to State Board of Health from various localities relative to the offensive condition at creameries that have not given proper attention to the disposal of their waste. Some time ago authority was given by this Board to certain representatives of the Dairy and Food Commission to act as sanitary inspectors and these agents as they inspect the creameries throughout the state note carefully their sanitary conditions. As a result of this co-operation between these two state boards the sanitary conditions at creameries seem to have improved. There is room for still further improvement.

RELATING TO MILK SUPPLIES.

The State Board of Health has taken an interest in this question.

(a) Throughout the state at large.

(b) In the districts surrounding the twin cities.

At the Board meeting, July 11, 1899, the following suggestion of the secretary was adopted, by motion:

In view of the fact that Illinois, Pennsylvania and any other states have taken steps to prevent the importation of cattle for dairy purposes that have not passed the tuberculin test, and also that the larger cities are demanding a certificate showing that dairy cattle are free from tuberculosis, it is desirable that this board notify the breeders and dairymen throughout the state to the effect that if they will secure inspection at their own expense, under our supervision, and will keep their herds in good sanitary condition, we will grant them a certificate indorsing the good character of their dairies. Such a plan has been tried in Indiana, and has been found to work favorably.

The recommendations of the executive committee meeting, July 10, 1899, were to the effect: /

That an inspector be employed to look after the quarantine of domestic animals, chiefly about the two cities; that such inspector shall receive not to exceed $100 per month, he to furnish his own transportation from place to place and to pay his own expenses. That the above inspector shall be in the employ of the State Board of Health, and subject only to instructions of its representatives, but that in consideration of this work being done in part for the benefit of the two cities, St. Paul and Minneapolis, they be invited to pay each one-fourth of the monthly wages, the state board of health proportion (one-half) to be paid out of the veterinary fund.

By motion, the above recommendation was approved and granted.

Dr. Reynolds was requested to secure, if possible, a pledge from the two cities, as suggested above, and to report results to the executive committee at its next meeting.

Mr. W. J. Pomplun received the nomination from Dr. Reynolds, to act as such inspector, and his nomination was approved.

The cities never did anything towards defraying the expenses of this man although his employment was entirely for their protection. This inspector has been continuously in the employ of the State Board of Health since August, 1899. His work about Minneapolis was changed somewhat after the meeting at the Board's office, June 24, 1902, when both Drs. Hall and Keys expressed a wish that the State Board should thereafter leave matters pertaining to the testing of cattle in the country district tributary to Minneapolis entirely in the hands of the Minneapolis authorities and township officials.

Early in the spring of 1901 it occurred to the State Board of Health that it would be well to have an inspection made of all dairies tributary to the twin cities in order to judge as to the sanitary methods employed by the dairymen in the care of their cows. Dr. Annand, of Minneapolis, was employed for this special work. In order to aid him in this work he was instructed to call at the health office of both Minneapolis and St. Paul and obtain a list if possible of all the dairies serving each city. He first called at the Minneapolis healh office and made this request. The list of dairies was turned over to him and he was working at it when he was interrupted by Dr. Hall who refused him the privilege of using such records, maintaining that Dr. Annand was trying to secure the same surreptitiously. He mentioned that the request for the use of these records should have been made first to himself. (If anyone

was responsible for this possible lack of courtesy it was Dr. Hall's own clerk. When Dr. Annand made his request he should have been referred by the clerk to Dr. Hall who was in his office at the time.) Later, upon Dr. Bracken personally explaining to Dr. Hall the purpose for which this list of dairies was sought, he gave Dr. Annand permission to copy same. Dr. Annand continued this work of dairy inspection until late in the spring when the housing of cows was discontinued. The same work was taken up by Thomas Wennerblom, Feb. 27, 1902. These two inspections were intentionally made during seasons when the dairy barns as well as the cows were at their worst, viz., at the latter end of the winter season, the intent being to note the conditions requiring sanitary attention. Most of the dairies in and close to the twin cities, distributing milk directly to consumers, were covered in this inspection. The records are on file in the State Board of Health office. The nature of the inspection is made plain by the attached blank.

Minnesota State Board of Health—Infectious Disease of Animals.

DAIRY SHEET RECORD.

Date..........................

No.................. Herd of..

Located at...

(City, Village or Township.)

Breed of cattle...

Bulls: No. tuberculin tested.................. Breed..................

No. not tuberculin tested.............. Breed..................

Cows: No. tuberculin tested.................

No. not tuberculin tested..............

Calves: No. heifers...........................

No. bulls...............................

No. of cows on hand when herd first tested...............................

No. of cows still on hand from first test...................................

No. of tuberculin tests of herd.................. Dates..................

If cattle tested, number each time: 1st......... 2nd......... 3rd.........

No. reacted on first test....................... Date..................

No. reacted on second test..................... Date..................

No. killed.................................. Dates.........................

No. passed as fit for food............... No. condemned.................

No. tested cattle purchased since first testing of herd......................

Dates ....

No. nontested cattle purchased since first testing of herd..................

Dates ....

Total number of cows owned since the first testing of herd.................

No. of tested cows on hand........ No. of nontested cows on hand........
Condition of cattle..
(Poor, fair, good, excellent.)
Character of feed used...
Date of beginning business...
How much milk sold daily...
Where is milk kept...
Surroundings of stable...
....
Style of stable (photograph).
Interior condition of stable...
(Dark, light, damp, dry, well ventilated.)
Style of fastenings for cattle.......................................
Style of stall...
No. of cubic feet per animal (estimated).............................
Who tested cattle each time..
....
....
By order of..
(Local board of health, owner, or state board of health.)
Remarks ....
....
....
....
....
....
....Name and Address of Reporter.
....

In May, 1901, after the passage of the law providing for partial compensation to dairymen whose cattle were condemned by the tuberculin test, upon the request of Dr. Bracken, Drs. Ohage, Hall, Kirby and Keys, met with Drs. Brimhall and Bracken to discuss the action to be taken in the appraisal and inspection, also disposal of animals condemned by the tuberculin test. Dr. Bracken suggested to the representatives of Minneapolis and St. Paul that the appraisal, slaughter and inspection of these cattle would be much simplified if it could be done by one and the same party for the various local authorities on certain specified killing days at the points indicated. He further pointed out that unless such an arrangement was made it would be necessary for representatives from each and every local board having cattle killed to be on hand on the killing days. Dr. Bracken stated that the State Board of Health would be willing to represent the cities of St. Paul and Minneapolis in the appointment of an appraiser, as provided by law, for the local Board of Health. The officials representing both St.

Paul and Minneapolis seemed to appreciate the advantages of such an arrangement and stated that they would be quite willing that the State Board of Health should represent them both in the appraisal and inspection of cattle condemned for tuberculosis.

The same proposition was made to the town boards of health in the country surrounding the two cities and they too were only too glad to accept the proposition of the State Board of Health.

At a meeting, Oct. 23, 1901, it was suggested by the state officials that some action be taken jointly in the twin cities looking to the establishment of a dairy mart in one or both cities where only tested cattle could be brought. The state officials expressed their willingness to aid in this work. Many of the dairymen had expressed a willingness to pay an extra price for tested cows, stating that at that time they were unable to purchase tested cows as there were none in the market. Nothing has been done by either city along the lines of the above suggestions.

In order to improve the condition of the herds at large throughout the state the breeders of cattle were encouraged to have their herds tested. Those wishing such action were requested to fill out a blank like the attached, and sent to the Veterinary Department of the State Board of Health.

....

To the State Board of Health, St. Paul,

Gentlemen: I wish to establish and maintain a herd of cattle which is free from tuberculosis, and I wish to have my entire herd inspected and tested with tuberculin and the diseased animals disposed of according to the rules of the State Board of Health.

I understand that this first test is to be made at the expense of the state, and in consideration of these services I agree to observe the precautions recommended by your board to keep my herd free from tuberculosis.

My herd includes the following animals: Cows......................; heifers over one year old......................; bulls over one year old......................; steers......................; calves under one year old......................; total...................... The cattle are ....

(State breed and whether registered.)

Respectfully,

....

(Address.) ....

In June, 1901, various dairymen were consulted with by the State Board of Health authorities relative to greater care of their cows and barns. In August a white-washing machine was placed

at the disposal of dairymen, without charge. They were also instructed in its use. The advantages of this machine over whitewashing by hand were, greater thoroughness and rapidity. We are informed that since the introduction of this machine by the State Board of Health the Dairy and Food Commission has also secured one or more such machines which they have placed at the disposal of dairymen.

As neither Dr. Brimhall nor myself felt that the people were securing a safe milk supply by the occasional testing of dairy herds alone we submitted the following proposition to the health boards of the twin cities, June 24, 1902:—

While we indorse the tuberculin test as a means of recognizing the presence of bovine tuberculosis, we do not consider the present methods employed in St. Paul and Minneapolis, viz., the testing of cattle, the condemning of those which react to tuberculin test, the removal of such condemned animals from the herd, the purchase of other animals to take the place of those condemned—such purchased animals not having been submitted to the tuberculin test—and the continued use for dairy purposes of such untested animals for an indefinite period, as tending to secure a nontuberculous milk supply. We, therefore, suggest one of the following propositions:

(1) That the compulsory testing of dairy herds be continued only on condition that some means are provided by which dairymen can replenish their dairy herds with tuberculin tested cattle.

That no dairyman be permitted to sell milk, in either city, from a herd containing any untested cattle.

That attention be given to the disinfection of dairy barns from which condemned animals have been removed.

That proper attention be given to the ventilation and general sanitation of dairy barns and the places in which milk is stored.

That sufficient inspection be made of these places to secure a permanent improvement of dairy barns and milk supplies.

(2) That if the above plan is not feasible, the testing of dairy herds with tuberculin be discontinued until such time as it can be adopted, recognizing as a reason for the discontinuance of such testing the fact that the present method is unsatisfactory, and is not yielding the results claimed for it.

Dr. Ohage was not present and no action was taken for St. Paul, but both Dr. Hall and Dr. Keys stated that they were not ready to accept either proposition. Thereupon Dr. Bracken and Dr. Brimhall suggested that it would be advisable for the State Board of Health to withdraw from further connection with the imperfect system then in use in an attempt to secure a safe milk supply—a system that must eventually bring the action of the board into disrepute. Both Drs. Hall and Keys thereupon expressed a willingness that the State Board of Health should withdraw entirely from

the work connected with the inspection and quarantine of dairy cattle tributary to Minneapolis, leaving the matter entirely to the city and township authorities. This course has been followed therefore for Minneapolis since June 24, 1902.

The State Board has not, however, given up its efforts to secure a better milk supply for the people of the state. At its meeting July 9, 1902, the following was adopted:—

> *Resolved*, that the State Board of Health grant special certificates to dairymen who conform to the requirements of said board, with reference to the testing (with tuberculin) of cattle, and to the care of barn and of milk.

Sept. 1, 1902, Dr. Bracken read a paper before the Hennepin County Medical Society, entitled "A Safe Milk Supply."

During August, 1902, Drs. Brimhall and Bracken began visiting various dairymen with the hope that they might be able to persuade them to keep only tested cows and to put their dairy barns and milk houses in such condition as to furnish a safe milk supply. As opportunity has been offered, study has been made of the various dairies throughout the country that are furnishing certified milk in the cities of Chicago, Baltimore, Philadelphia, New York, and in Essex County, New Jersey.

Under the Influence of the State Board of Health the medical societies of Hennepin and Ramsey counties have taken up the consideration of the milk problems.

LICENSED EMBALMERS.

The system established by this Board in 1898 of licensing embalmers has proven a success and there are at present 237 embalmers in the state holding our special license. Under this system the shipping of bodies is much simpler than it was in the past and as a consequence the transportation of the dead is more general. At the same time it is coming more and more under the control of licensed embalmers, and the complaints on account of irregular shipments or improperly prepared bodies shipped are becoming less frequent.

At the meeting of the Board July 9, 1901 measures were taken to still further restrict the shipment of the dead by non-licensed embalmers (see p. 134).

The best results relative to the licensing of embalmers have been secured in states where action has been taken through the

state boards of health, and where the question has been handled as a sanitary proposition rather than simply a question of licensing. As a sanitary proposition a state board of health can, if properly provided for, say who is and who is not able to so prepare a body for shipment as to avoid its becoming a nuisance, or a source of danger when death has been due to a communicable disease, while in transit. The states that regulate the issuance of a license to embalmers through their boards of health as a sanitary rather than as a legislative proposition are the following: Colorado, Illinois, Iowa, Kansas, Louisiana, Minnesota, Michigan, Montana, New Hampshire, North Carolina, North Dakota, South Carolina, South Dakota, Utah, Washington and Wisconsin. Oklahoma is also under sanitary control through the territorial medical examining board rather than the Board of Health.

Alabama, Georgia, Indiana, Missouri and Nebraska license embalmers under a special law and only after an examination. In some instances if not all these states are under sanitary restrictions.

Certain states having no licensing system of their own depend upon neighboring states. This applies to Idaho and Wyoming which depend upon license issued from Utah and to New Mexico which depend upon license issued from Colorado.

In many states where an attempt has been made to regulate the licensing of embalmers through legislation rather than through sanitary regulations such opposition has been made by undertakers already in business that it has been impossible to secure a law requiring that *all* embalmers shall be licensed only after an examination. In these states, undertakers who have been in practice a certain number of years are entitled to a license *without examination.* These men are known as *exempts* and their license is a legal document only and not an evidence of ability to properly prepare a body for shipment or burial. The license of these *exempts* cannot be accepted by sanitary bodies in their regulations governing the transportation of the dead. The states that are under this imperfect licensing system at present are New York, Ohio, Pennsylvania and West Virginia.

In dealing with the safe shipment of the dead judged from the sanitary point of view it is necessary for other licensing states to refuse these *exempts* the privilege of preparing bodies for shipment into their jurisdiction. If an *exempt* has any real respect for himself it would seem wise for him to voluntarily submit himself to an

examination thus demonstrating his fitness to be classed with embalmers who are up to date judged from a sanitary point of view.

The states not mentioned in any of the foregoing lists have as yet no system of regulation for their embalmers, and consequently no sanitary regulations governing the transportation of dead bodies.

There are four parties interested in the transportation of the dead:

(1) The relatives.
(2) The embalmer.
(3) The railroads.
(4) Sanitary bodies.

It is the duty of the last three interested parties to meet the wishes of those who represent the first party in providing for safe and decent transfer of their dead from point to point. The credit of securing satisfactory transportation regulations rests largely with the Conference of State and Provincial Boards of Health of North America, the National Funeral Directors Association, and the American Association of General Baggage Agents.

SCHOOL INSPECTION.

Absolutely no progress has been made during the past two years along these lines. Judging from results, it seems difficult to secure the co-operation of those high in authority in educational matters, where sanitary problems are under consideration. So far as I am aware there is little if any provision made for sanitary instruction in our normal schools, colleges, or university, and little if any interest shown by educational organizations throughout the state in sanitary problems.

WATER SUPPLIES.

The board has realized its responsibility in dealing with these questions. The law bearing upon this subject reads as follows:

No sewage, drainage or refuse or polluting matter of such kind as either by itself or in connection with other matter will corrupt or impair the quality of the water of any spring, well, pond, lake, stream or river for domestic use, or render it injurious to health, and no human or animal excrement shall be placed in or discharged into, or placed or deposited upon the ice of any pond, lake, stream or river, used as a source of water supply by any town, village or city; nor shall any such sewage, drainage, refuse, or polluting matter or excrement be placed upon the banks of any such pond, lake, stream or river, within five miles above the point where such supply is taken, or into any feeders or the banks thereof, of any such pond, lake, stream or river.

The State Board of Health shall have the general supervision of all springs, wells, ponds, lakes, streams or rivers used by any town, village or city as a source of water supply, with reference to their purity, together with the waters feeding the same, and shall examine the same from time to time, and inquire what, if any, pollution exist, and their causes. In case of a violation of any of the provisions of section one (1) of this act, said board may appoint a time and place for hearing parties to be affected, and shall give due notice thereof, as hereinafter provided, to such parties, and after such hearing, if in its judgment the public health requires it, may order any person or corporation, or municipal corporation to desist from the acts causing such pollution, and may direct any such person or corporation to remeay the pollution, or to cleanse or purify the polluting substance, in such a manner and to such a degree as shall be directed by said board, before being cast or allowed to flow into the waters thereby polluted, or placed or deposited upon the ice or banks of any of the bodies of water in the first section of this act mentioned. Upon the application of the proper officers of any town, village or city, or of not less than legal voters of any such town, village or city, to said State Board, alleging the pollution of the water supply of any such town, village or city, by the violation of any of the provisions of this act, said State Board shall investigate the alleged pollution, and shall appoint a time and place, when and where it will hear and examine the matter, and shall give notice of such hearing and examination to the complainant, and also to the person or corporation, or municipal corporation alleged to have caused such pollution, and such notice shall be served not less than ten (10) days prior to the time so appointed, and shall be served in the same manner that now is, or hereafter may be, by law provided for the service of a summons in

a civil action in the district court. Said board, if in its judgment any of the provisions of this act have been violated, shall issue the order or orders already mentioned in this section.

The district court, or the judge thereof, may upon the complaint of said State Board, or of the proper authorities of any town, city or village whose sources of water supply shall be so polluted, issue an injunction to enforce the orders of said State Board.

Such orders of the State Board shall be served upon the persons, corporations, or municipal corporations found to have violated any of the provisions of this act, and any party aggrieved thereby, shall have the right to appeal to the district court of the county in which is situate the town, village or city whose source of water supply is found to have been polluted, and such aggrieved party shall have the right to a trial by jury in the same manner as in a civil action in said court. During the pendency of the appeal, the pollution against which the order has issued shall not be continued contrary to the order of the State Board, and upon the violation of the order the appeal shall forthwith be dismissed.

Any person, corporation or municipal corporation desiring to appeal from any such order of the State Board, shall, within thirty (30) days after the service upon him or it of a copy of such order, file in the office of the clerk of the district court of the proper county, a notice of such appeal, together with a bond in the sum of not less than two thousand (2,000) dollars, with two (2) sureties, to be approved by the judge of said court, conditioned for the prosecution of such appeal to judgment and for the payment of all the costs and disbursements that may be adjudged against him or it therein, and shall, within three (3) days after such filing, serve a copy of such notice and bond upon the secretary of said board; and said secretary shall, within ten (10) days thereafter, deliver such copies so served upon him to the mayor or other chief executive officer of any such city, village or town whose source of water supply has been found to have been so polluted.

Water boards, water commissioners, water companies, and the proper officers of any city, village or town, making use as a source of water supply, of any well, spring, pond, lake, stream, river, reservoir or well, within, or partly within, this state, and distributing the waters thereof for public, domestic and general uses, shall, from time to time, and whenever required by said State Board, make returns to said board, upon blanks to be furnished by it, of such matters as may be required by said board and called for by such blanks, and any such water board, water commissioners, water company, or officers of any city, village or town, who shall, for the space of thirty (30) days after being furnished with such blanks, fail or neglect to make any such report so required, shall, for each and every such neglect or failure, forfeit and pay the sum of one hundred (100) dollars, for the use of the Local Board of Health, or the proper officers acting as such, of the city, town or village where such delinquent has its principal office. Said State Board shall, in the name of the state, prosecute in the district court of the proper county an action for the recovery of the penalty or forfeit herein imposed.

July 16, 1902, the board issued a circular letter drawing the attention of the proper officials to this law and advising that when

new water plants or sewerage systems were to be put in, or old ones extended or repaired, the State Board of Health be advised of the fact in order that it might give an opinion as to the sanitary requirements. It was the wish of the board to be helpful in these matters and to save cities and villages, as well as corporations and state institutions, from needless waste of funds. It certainly is needless for any party to spend money in instituting either a water plant or sewerage system that is subject to condemnation as soon as it is completed should the State Board decide in the one instance that the water supply was not fit for use, or in the other instance that the sewage would contaminate water. The attitude of the board is shown by the following taken from the circular letter:

> We trust you will appreciate the position of the State Board of Health in its effort to aid the various villages and cities throughout the state in securing and maintaining pure water supplies. It is the wish of the board to prevent the construction of unsanitary water plants, or sewerage systems, and the consequent waste of money.

The attention of sanitary engineers has also been called to this action of the board, and they have been requested to urge upon municipalities the necessity of guarding well their sources of water supply. That something should be done towards improving the water supply is well illustrated in the typhoid fever table, pages 202-204.

It is worthy of note that in this table the deaths reported from the country district (261) is almost as great as that reported from villages and cities having a population of 2,000 or over (302). This is not according to the popular impression that typhoid fever is largely a city disease. The fact may be explained in various ways. Many of the cases may have contracted the disease in the city and then gone to their homes in the country where they died, or the pollution of rural drinking waters may be more general than is supposed. Both of these points are worthy of attention. It is undoubtedly a fact that many typhoid fever cases from the country and small villages find their way into hospitals and thus tend to swell the apparent typhoid death rate of many cities. The analyses of waters throughout the state as given under the chemist's report show that it is high time for our people in both city and country to give more attention to the purity of drinking water. The records of a few places where typhoid fever has prevailed may be used for illustrative purposes.

Minneapolis, with her recognized impure water supply, still holds first place (65 out of 302 deaths from typhoid fever in cities

and villages having a population of 2,000 and over). Duluth still shows a high death rate (47 deaths). In this city the shallow wells still in use and the imported hospital cases are responsible for the continuance of this disease. The St. Paul typhoid fever records (35) are made up of cases infected from shallow city wells and imported cases.

St. Cloud had quite an epidemic. This city had been complaining of the quality of its water supply for some time prior to 1901. Its contract with the water company called for a supply of water that would meet the sanitary requirement of the State Board of Health. Repeated chemical and bacteriological examinations showed the water to be of poor quality and not fit for domestic use. Finally there was an epidemic of typhoid fever, fully confirming the opinions that had previously been given as to the unsanitary quality of this water. The necessity of securing a good water supply for this city was quite apparent. By appointment with Dr. J. B. Dunn, health officer of St. Cloud, Mr. Geo. L. Wilson, C. E., and Dr. H. M. Bracken, secretary of the State Board of Health, met with the St. Cloud city council May 9, 1902, to discuss the proper course to pursue in order to secure a safe water supply for that city. After looking the ground over prior to the meeting, it was quite apparent that steps should be taken at once to secure a different water supply; that the only satisfactory method of so doing would be by filtration of the river water; that any filtration method adopted would need careful supervision in order to secure satisfactory results; that mechanical filtration would be cheaper and probably more satisfactory than sand filtration; that the State Board of Health was ready to stand back of the city in its attempt to secure a pure water supply, and was ready to keep a close watch upon the water, both chemically and bacteriologically, should a system of filtration be established; that any system of filtration adopted for the city should be recognized as acceptable only through the results produced, as shown by chemical and bacteriological findings.

Mr. Reynolds, attorney for the present water company, stated that the owners were ready to put in a mechanical filter if the city would guarantee the payment to them of the hydrant rents now due them. He was advised that if the present company were to make a contract with any mechanical filter company to put in a filter, it should state in the specifications that the filter contracted for should produce a satisfactory standard of purity, as judged from the chemical and bacteriological point of view. Such a con-

tract would protect the company from the purchase of an unsatisfactory filter.

MR. GEO. L. WILSON'S REPORT ON PRESENT WATER SUPPLY AT ST. CLOUD, MAY, 1902.

The public water supply is furnished by pumping the water directly from the Mississippi river into the city mains. The water is taken from a point some 800 feet above the pumping station, which is on the river bank. A submerged timber crib is located about 100 feet out in the stream, where there is a good current and a depth of water of six to eight feet. From this crib a 16-inch cast iron pipe leads to the shore, from which point an 18-inch vitrified pipe conducts the water to the pit or reservoir in the pumping station. This pipe is situated along the edge of the stream for a distance of about 100 feet, where it crosses in front of and at a depth of four feet below the outlet of a public sewer, which will be taken up later in this report.

An examination along the banks of the river above the intake crib showed that the ravines and edges of the high ground a short distance from the river had been used as a dumping ground for manure and various wastes from the city, and there was good opportunity for the river to receive the drainage and washings from these dumps, which extended for three-quarters of a mile up the river.

Some two miles up the river is the small town of Sauk Rapids of about 600 people, but with no sewers. The nearest town of any size is Brainerd, about thirty miles up the stream. From the amount of population above St. Cloud, and the fact that the river is used largely for lumbering operations, it is evident that considerable organic matter will be brought down, and the analyses of the State Board of Health show that the water taken directly from the river is not fit for drinking purposes without purification.

An examination of the currents in the river near the intake crib made on the 17th, and repeated on the 18th, with a strong wind blowing up stream, showed that unless there was a jam of logs above the intake to act as a dam, no sewage from the city sewer could pass up stream and reach the intake crib. From the examination it appears that the crib is located sufficiently far above the sewer so that no danger exists at the intake so long as there is no jam of logs above the crib.

An examination was made of the intake pipe. An excavation to uncover the pipe was started near the sewer outlet, but did not

reach the pipe. The intake pipe was cut off from the river and the vitrified pipe and reservoir in pumping station emptied. An examination of the pipe showed that there was considerable leakage into it, and as the ground through which the pipe passes is saturated with sewage near the sewer outlet, the conditions are favorable for a direct contamination from the sewage emptied at this point, and as the existing sewer has a plank bottom this condition might continue if the sewer should be extended down the river bank below the pumping station. That water from the ground near sewer outlet can pass into the intake pipe was proved by direct observation at the excavation above referred to, and also by chemical tests made of the leakage, water flowing from the pipe when the river was cut off.

An inspection of the pump house reservoir, when nearly empty, showed that it is reasonably tight. A small amount of water, however, percolates into it near the top, and as on the hillside above there are cesspools and privy vaults, the ground water here is probably badly contaminated, and even a small inflow adds to the impurity of the city water.

As a result of the investigation made by the writer, it may be stated that the river receives washings from dumps near the banks above the water works. These dumps should be cleared away and all dumping in the vicinity stopped. It may also be considered that the water flowing through the vitrified pipe intake is contaminated from the ground water coming from the city sewer and the surrounding drainage.

The remedy for this is evidently to replace the present vitrified pipe by a cast iron pipe. At the pumping station drainage should be provided outside the building to cut off all flow from the surrounding ground into the reservoir.

An examination of several proposed sources for obtaining a water supply for the city from other places than the river was made, but it is the opinion of the writer that there is no other source available where all the conditions are as satisfactory as the Mississippi river when all points are considered.

The last suggestion to be made in closing this report is a recommendation that your city should demand that its public water supply be purified or filtered, as called for by city ordinance No. . ., under which your water is now furnished.

There are several methods of filtration which are in successful operation in other cities, several on the Mississippi river itself, and the results obtained are very satisfactory. The experience of

cities is that, with a purified water supply, such epidemics as that now prevailing in St. Cloud do not occur, and it would appear that the duty of your city government is plain.

Other cities and villages that may be noted as furnishing undesirable typhoid legal records are Detroit, Bemidji, Brainerd, Montevideo, Moorhead, Hutchinson, Fairmont, Little Falls, St. Peter, Worthington, Fergus Falls, Crookston, Owatonna, Wadena, Breckenridge, Ortonville, Park Rapids, Lakefield and Perham.

Of county districts, especially affected, were Becker, Benton, Clay, Cottonwood, Crow Wing, Lincoln, Lyon, Marshall, Martin, Meeker, Nobles, Otter Tail, Polk, Redwood, Renville, St. Louis and Sibley.

In many of these country districts it should be noted that they are contiguous to cities having a bad record as regards typhoid fever. Of course these typhoid fever records indicate the existence of unsafe water supplies.

The laws relating to the pollution of waters were ably summarized in 1900 by Rome G. Brown, Esquire, of Minneapolis, in a paper presented before the American Water Works Association. Through the courtesy of Mr. Brown, this paper is here reproduced with additional information bringing it up to date.

A SUMMARY OF THE LAW RELATING TO POLLUTION OF WATERS OF LAKES AND STREAMS.

BY ROME G. BROWN, ATTORNEY-AT-LAW, MINNEAPOLIS, MINN.

(The References "1," "2," etc., are to List of Authorities annexed.)

"O the One who acts according to his Heart, gone out of Sahou! I did not soil the water."—(Line 28, Sec. B, Ch. 125, Egyptian "Book of the Dead.")

THE ANCIENT SOURCES OF OUR MODERN LAWS AGAINST POLLUTION.

The laws which govern most of our personal and property rights have shown changes, sometimes very radical, from the laws of earlier times. But it is an interesting and significant fact that even the latest decisions of American courts affirming judgments against offenders who have polluted streams or lakes are based upon certain general principles of law which have always made such acts of pollution both private and public wrongs in the civil

and penal codes of all nations and which have remained unchanged from the earliest forms of written law known in history to the present time. These principles, and the law which arose from them, can be read to-day in the manuscripts which, written in hieroglyphics and pictured in crude outline drawings, were buried with the Egyptian princes who lived, fought and died upon the banks of the Nile thousands of years before the migration of the founder of Israel into the land of the Pharaohs.[1] To these ancient worshipers of nature the waters of the Nile and of all its tributaries were a divine gift for the use and comfort of many. An individual might own the banks upon the shore and might have certain rights by virtue of his ownership; but the flowing water sent down the streams by the God of the Nile no man could appropriate, divert, or pollute without committing an offense which not only subjected him to punishment under the civil code, but made him subject to condemnation when Osiris, the God of the lower world, should pass judgment upon his soul. And in the negative confession which the departed soul made in the judgment hall of the lower world before the forty-two judges of the dead, no protestation was more repeated nor more emphasized than the one above quoted, which was addressed to the one judge whose sole duty it was to determine whether the deceased had at any time in his life committed the grievous sin of polluting the natural waters of the earth. Carved upon the inner and outer walls of the ancient temple, pictured upon the halls of the dead, the mummy cases and in manuscripts, is found everywhere in the literature of that people the law against the pollution of the waters which nature had provided for man's use and which, in order that man should be protected in the uses for which they were intended, must be kept pure and undefiled. The modern law against the pollution of waters is founded upon these early established principles of the law of waters: (1) That they are nature's gift; (2) that they are given, not for appropriation and ownership, but for the use and comfort of man; (3) that man's right is that only of a usufruct; (4) that in order to protect that use, any pollution must be forbidden.

The same ideas are expressed in the Lord's reproof of the shepherds, which is found in Ezekiel, showing that the ancient Hebrews recognized the same principles of law against the pollution of water:

> Seemeth it a small thing unto you to have eaten up the good pasture, but ye must tread down with your feet the residue of your pasture, and to have drunk of the deep waters, but ye must foul the residue with your

feet? And as for my flock, they must eat that which ye have trodden with your feet; and they drink that which ye have fouled with your feet. (Ezekiel xxxiv, 18 and 19.)

The Roman law held that rivers belong to a class of things *utilitatis innoxiae* and that, of natural right, flowing water, the air, the sea, and the shores of the sea, are common property; that all rivers that flow perpetually are public, and that the right of fishing therein and the use of the river banks are public also; and that property in flowing water cannot be taken to belong to any one. Individuals have only a usufruct therein, and that in common with all others; and that this right cannot be legally destroyed or impaired by any one.[2]

The English common law held that while land was the subject of private property, flowing water was not; and Blackstone says:

Water is a movable, wandering thing, and must of necessity continue common by the law of nature; so that I can only have a temporary, transient, usufructuary property therein; wherefore if a body of water runs out of my pond into another man's, I have no right to reclaim it. Buy the land, which that water covers, is permanent, fixed and immovable, and therefore in this I may have a certain substantial property, of which the law will take notice, and not of the other.[3]

The same principles are the foundation of the American law of pollution. These are stated by Kent as follows:

Every proprietor of lands on the banks of a river has naturally an equal right to the use of the water which flows in the stream adjacent to his lands, as it was wont to run (*currere solebat*), without diminution *or alteration*. No proprietor has a right to use the water, to the prejudice of other proprietors, above or below him, unless he has a prior right to divert it, or a title to some exclusive enjoyment. He has no property in the water itself, but a simple usufruct while it passes along. *Aqua currit et debet currere ut currere solebat* is the language of the law. * * * The owner must so use and apply the water as to work no material injury or annoyance to his neighbor below him, who has an equal right to the subsequent use of the same water; nor can he, by dams or any obstruction, cause the water injuriously to overflow the grounds and springs of his neighbor above him. Streams of water are intended for the use and comfort of man; and it would be unreasonable and contrary to the universal sense of mankind to debar every riparian proprietor from the application of the water to domestic, agricultural and manufacturing purposes, provided the use of it be made under the limitations which have been mentioned; and there will, no doubt, inevitably be, in the exercise of a perfect right to the use of the water, some evaporation, and decrease of it, and some variation in the weight and velocity of the current. But *de minimis*

non curat lex, and a right of action by the proprietor below would not necessarily follow from such consequences, but would depend upon the nature and extent of the complaint or injury, and the manner of using the water. All that the law requires of the party, by or over whose land a stream passes, is that he should use the water in a reasonable manner, and so as not to destroy, or render useless, or materially diminish, or affect the application of the water by the proprietors above or below on the stream. * * * The just and equitable principle is given in the Roman law: *Sic enim debere quem meliorem agrum suum facere ne vicini deteriorem faciat.*

It will be seen that, however different in form of statement, the underlying principle which makes the pollution of waters illegal is always the same; that waters are a subject of common use, and that that use must be reasonable under all the circumstances, and must involve as little diminution, diversion or alteration, either in quantity or quality, as is consistent with the reasonable use to which the individual is entitled. Out of this general principle has grown the law of pollution and it governs the right of the individual in his use of the water, whether that right be as riparian owner for domestic, agricultural and manufacturing purposes, or whether it be in his use of the stream as a highway or other uses which he has of the water in common with other individuals. It applies as well to those streams which are small and known as private streams, as to those which are large and floatable for logs and ships and which are known as public streams. It applies to all sources of flow and supply, whether it be a lake as large as an inland sea or a natural spring supplying the small tributary which is only one of the thousand feeders of the larger streams below. Moreover, the right of the individual and the community to have a stream remain undefiled is subject to a less number of exceptions than is the right to have the stream flow in its natural quantity and direction. The right of a state legislature to authorize a diversion of the waters in a navigable stream for certain public uses, as against the natural rights of riparian owners, has been upheld;[5] but no such right to authorize the pollution of the waters of either a navigable or non-navigable stream has ever been recognized.

THE PRINCIPLE OF REASONABLE USE AS APPLIED TO POLLUTION.

The general principles of the law against the pollution of waters, as applied by the leading text writers upon the subject, are shown by the following:

In determining, therefore, what these rights of the respective riparian proprietors upon a stream are, two things are to be taken into consideration:

first, that to derive a value from this incident to his property, requires that the proprietor should apply the water to use in some form; and second, that whatever is true of his own right is true of every other proprietor above and below him. And from these a rule has been deduced, which is as near uniform as the nature of the case admits, and that is, that each proprietor may make any reasonable use of the watcr upon his premises, provided hc do not thereby essentially or materially diminish the quantity or corrupt the quality of water in the stream, so as to deprive othcr proprietors of a fair and reasonable participation in the benefits thereof. The uses to which water may be applied are so various, and the circumstances of the several cases where this is to be done are so diverse, that no more definite rule than this can be laid down. And whether, in any given case, a use shall have been reasonable or otherwise, must, as will be seen hereafter, ordinarily be referred, as a question of act, to a jury.

The casc of Holsman vs. Boiling Spring Co. may be citcd as illustrating the general propositions above stated. The plaintiff has a valuable estate and pleasure grounds upon a small stream, upon which the defendant had a bleachery above the plaintiff's works. The chemicals used in the bleachery and thrown into the stream corrupted the water, and rendered it unfit for the uses to which it had been applied by the plaintiff. In settling the respective rights of the parties upon thc plaintiff's application for an injunction to the fouling of the water by the defendant, the court held that every riparian proprietor had a right to the natural flow of the water of a stream, as well in quality as quantity. The right of a riparian proprietor to the use and enjoyment of a stream of water in its natural state is as sacred as the right of soil itself. If a mill has acquired a prescriptive right to foul the water in one mode or to a certain extent, it will not justify fouling it in another mode or to a greater extent. This does not depend upon what a riparian proprietor may have expended upon his estate, but applied to riparian estates universally.[6]

Again:—

It is clearly the duty of riparian proprietors. upon a watercourse, to refrain from erecting upon its banks any works which render the water unwholesome or offensive. * * * Neither can a riparian proprietor use the water in a manncr so as to corrupt the atmosphere. * * * In Wood vs. Sutcliffe, an injunction was asked for to restrain the defendant from pouring into the stream any dye-wares, or dye-liquors, or madder, or indigo, or potash, or mattcrs of that description, which tend to pollute thc stream, to the damage of the plaintiff's works. And by the vice-chancellor, "I conceive that if the plaintiffs have established such a legal right as that which I have mentioned, and while they are in the enjoyment of that right another person comes and erects machinery, or any manufacturing works, on that stream above the plaintiffs' works, and by his manufacturing process so fouls that water as that instcad of coming as before, pure and unsullied to the plaintiffs' works, it arrives at the plaintiffs' works in a less pure and serviceable state than before, so as seriously and continuously to obstruct the effective carrying on of that plaintiff's manufacture, if that be the case, and if the restraining of those acts by injunction will restore or tcnd to restore the plaintiffs to the position in which they have a right to

stand, and in which they before stood; and if the injury which is occasioned by the works complained of is of such a nature as that the recovery of pecuniary damages would not afford an adequate compensation, that is such a compensation as would, though not in specie, in effect place the plaintiffs in the same position in which they stood before; and if, moreover (for there were several conditions), the plaintiffs do not sleep on their rights and do not acquiesce, either actively or passively, in the acts which they complain of, but use diligence and vigilance to take such steps as are proper and necessary for the vindication of their rights, if those conditions occur in such a case as that which is now presented here, the plaintiffs, the parties so injured, have, I conceive, as a general rule, a right to come to the court of equity and say: Do not put us to bring action after action for the purpose of recovering damages, but interpose by a strong hand and prevent the continuance of those acts altogether, in order that our legal rights may be protected and secured to us. * * * It is not, however, under all circumstances an unreasonable or unlawful use of a stream to throw or discharge into it waste or impure matter. Whether such a use would be reasonable or not in any given case would be a question for a jury upon its circumstances. The same circumstances would be open for consideration and the same rules would govern, in this case, as in respect to the abstraction, detention, diversion or obstruction of water in a stream. The size and character of the stream, the uses to which it can be or is applied, the nature and importance of the use claimed and exercised by one party, as well as the inconvenience or injury to the other party, would be subjects involved in the inquiry. In the construction and repair of mills and dams, in the excavations required for their foundations, and in the frequent removal of the gravel used for tightening such dams, the water must for a time, and necessarily, be rendered so impure as to cause inconvenience occasionally to persons engaged in a kind of manufacture requiring pure water. But if such building and repairs are reasonably conducted, the inconvenience must be borne just the same, and for the same reasons as the inconvenience caused by the temporary and reasonable detention of the water while filling the dam. So in the uses of a stream for purposes of agriculture, such as washing sheep, crossing it with teams, allowing cattle and swine to traverse it, the same principles will apply. So in the use of many kinds of mills, such as saw mills, fulling mills, cotton and woolen factories; there must be thrown into the stream more or less of the waste, such as saw-dust, soap-lees, and other impurities, and no ordinary care or prudence could prevent it. In other cases such disposition of the whole waste, although not absolutely indispensable, would add greatly to the productive value of the mill power. Whether, in either case, it may be rightfully done must depend upon the question whether, under all the circumstances of the case, it is or is not a reasonable use of the stream; and in determining that question the extent of the benefit to the mill-owner, and of inconvenience or injury to others, may very properly be considered. So in respect to the size and character of the stream, it is obvious that an amount of diminution or pollution which would be insignificant in a large stream might, in a small stream, be wholly destructive of the common right. So also in determining the reasonableness of suffering the manufacturer's waste to pass off in the current, much must depend upon the use to which the stream below can be or is applied; whether as a mere highway alone, or

for purposes of manufacture, requiring pure water, or for the supply of an aqueduct to a large city, as in the case of the Croton river; and in respect to the lands below adjacent to the river, the character of the banks, whether they are usually overflowed or not, in high-water, should be considered. And in determining the reasonabless of such use, evidence of usage in the deposit of such waste is admissable. Upon this last point in Snow vs. Parsons, the court said: "It is settled law that every riparian proprietor may use the water for the purposes of manufacture, but so use it as not unnecessarily to abridge the use to others; i. e., every such proprietor may use it with care and prudence. What care and prudence are in such case must depend upon the facts of each case, the conclusion to be drawn by the triers of the fact. And to assist them in making this conclusion, if they are not themselves experts in the business, they are entitled to have the experience and wisdom of such as are experts, to enable them to judge of the reasonableness of the particular use. The measure of reasonable care and prudence in such cases is that which prudent and careful men exercise in the management of their own business. And how are we to know this, without proof, in those departments of business with which we are not familiar? Proof that all prudent and careful men, in the management of the business of tanning, pursued a given course of discharging the spent tan into the stream, and that others acquiesced in that course without objection, would seem to be of the very essence of the inquiry before the jury in such cases."[7]

The right to an injunction in such cases on the ground stated is clearly established:

A deprivation of the use of a stream by corrupting it so as to render it unfit for use, is an equally irreparable injury, entitling the party injured to the like preventive remedy. When the nuisance operates to destroy health or to diminish the comfort of a dwelling, an action at law furnishes no adequate remedy, and the party injured is therefore entitled to protection by injunction.[8]

A perpetual injunction will be granted to restrain defendants from discharging water from their mines and colliery into a stream to the injury of plaintiff's work and mill below, the water thus pumped from defendants' mine into the stream being charged with sulphuric acid and other deleterious matters, causing great injury to plaintiff's boilers and other machinery.[9]

Frequent ground of application for the preventive aid of equity by injunction, is found in cases of the pollution of water by the flow of sewage from towns and cities into streams whose waters are thereby injured or rendered unfit for use. In cases of this nature the preventive jurisdiction of equity is well established, the general doctrine being that the fouling or pollution of water in a stream by such sewage constitutes a nuisance and affords sufficient ground for relief by injunction. In conformity with this doctrine, the owners of land upon the banks of a river below a city may enjoin the city authorities from polluting the river by sewage. And when a public or municipal body acting in excess of its lawful powers, is about to construct a sewer in such manner as to injure the water in a river, it may be restrained from proceeding. So an injunction is proper to restrain municipal authorities from opening additional sewers into a stream at a point on the stream

above plaintiff's premises, in such manner that the sewage fouls the water and renders it unfit for use. And a board of commissioners charged with the drainage of a town may be enjoined from permitting the sewage of the town to be discharged into a stream which passes through plaintiff's premises and supplies a lake thereon, when such sewage has an injurious effect upon the water in the stream and lake.[10]

Riparian owners have also a natural right to have natural streams flow unimpaired in quality as well as quantity; and any use of the stream by one proprietor, which defiles or corrupts it to such a degree as essentially to impair its purity and usefulness for any of the purposes to which running water is usually applied, is an invasion of private right, for which those injured thereby are entitled to a remedy.[11]

CIVIL REMEDIES AS ILLUSTRATED BY THE CASES.

The existence of a remedy in the law for injuries caused by pollution of waters is guaranteed by the fundamental rule that for every injury there is a remedy. This does not mean that, in every case where a person is only slightly damaged by some change in the quality of the flowing water, he will have a right of action. He has a remedy only for the *injuria*,—that is, for the infringement of his right. His right is governed by the rule of reasonable use; and, as is shown above, whether the change of quality in the water is one which exceeds the bounds of reasonable use is, in each case, a question of fact to be determined from all the circumstances in that case. It is clear, however, that the rule of reasonable use does not protect either an individual or the public in any material or substantial defilement of the waters of a stream naturally flowing past the land of another. The law prevents such pollution not only by individuals, but by communities and corporations, whether private or public; and on the other hand it protects from such pollution not only the individual but a community in general, and corporations, whether public or private, and whether the injury is to the latter's use for private purposes or for public water supply. The civil remedies may be sought and obtained in various forms under the general law of the land, and without statutory enactments. The injured party has a right to recover money damages for injuries which have been occasioned to him by reason of such pollution, and these damages will include all damages which are proximately the result of the pollution. But he is not confined to his action for money damages alone. He will be allowed an injunction against the continuance of the evil, and such injunctions have been granted to prevent the continuance of various forms of pollution.

Such remedies have been allowed many times and are being allowed in the courts to-day; and the right of remedy for such wrongs has been demonstrated and upheld in almost all the various conditions under which a defilement of waters is likely to occur.

POLLUTION BY MANUFACTURING AND MINING PLANTS.

Some years ago the Pennsylvania court held in the case of Sanderson vs. Coal Co.[12] that a pollution by mining operations upon a stream was not an infringement of the rights of lower proprietors; but in later decisions of the Pennsylvania courts the tendency seems to be to repudiate the holding in the Sanderson case. In three recent decisions it has been held that such pollutions were unlawful, and that the deposit by a mining company of culm and refuse from its mines on the banks of a stream in such a position that ordinary floods would wash the refuse down to the injury of proprietors below, would give a right of action to such lower proprietors.[13]

In the same state it was held in 1898 that an injunction will be granted against the pollution of the Schuykill river by the deposit of culm, muck and dirt, which was injurious to the property rights and the health of owners on the stream below.[14] Also that one owner is liable to an adjacent owner for polluting the latter's springs by an improper method of boring for oil or gas by which salt water was allowed to rise and mingle with the fresh water on the latter's lands.[15]

In a recent New Jersey case, a riparian owner brought a bill for an injunction against a mining company for discoloring the waters of a stream. The discoloration and pollution were caused by a fine clay amounting almost to a pigment, having a high reddish tint and intermixed with a small quantity of very fine sand. The complainant was owner of a paper mill below, and it was shown that the polluting elements introduced by the defendant were injurious to complainant. The question of pollution is very thoroughly discussed and it was held: 1. That the doctrine of Sanderson vs. Coal Co., which was so long litigated in the Pennsylvania courts, was not in accordance with the law of pollution, and the repudiation of that Pennsylvania authority which had been announced by the Ohio courts in the case of Iron Co. vs. Tucker, 48 Ohio St. 41, was adopted by the New Jersey court. 2. In the same decision the court holds that the Massachusetts case of Merrified vs. Worcester, 110 Mass. 216, in so far as it is in favor of the notion that a city

may discharge sewage matter into a fresh water stream, to the injury of a riparian owner, is contrary to the best authority. 3. It has also held that the fact that the stream had for many years been polluted to some extent by the same or similar methods was no defense in this action; the fact that there were other and prior nuisances of the same kind gave the defendants no right to participate in the pollution or to render the waters more polluted. 4. It was held that an injunction was a proper remedy and that it should be granted in that case.[16]

So in Maryland the befouling of the waters of a stream by an upper proprietor so as to injure a lower proprietor's use of the water in his whiskey distillery was held actionable.[17] In Mississippi the pollution of a stream by a manufacturing company to the injury of a lower proprietor gives the latter a right of action for damages; and the fact that the pollution was caused by a company carrying on a large business of a quasi public nature does not affect the right of the party injured to have his remedy.[18] In Alabama it has just been held that an upper proprietor cannot pollute a stream with mining refuse so as to render it unfit for the domestic use of a lower owner.[19] In Georgia it is held that the adulteration of a stream by washing ore in it so as to render it unfit for the use of a lower owner will be actionable, and this, although the stream may be more useful for mining than for domestic purposes.[20] In South Carolina it is held that the discharging of deleterious refuse into a creek which kills fish and causes noxious vapors to be exhaled from the stream in the vicinity of plaintiff's home, gives the plaintiff a right of action.[21] In California it was held that one appropriator of the waters of a stream cannot pollute the remaining waters of the stream to the detriment of other users, and that any other user cannot be compelled to protect himself from such injury at his own cost, although he could do it at less expense than would have to be incurred by the wrong-doer.[22] In New Hampshire it is held that the rule of reasonable use does not allow a manufacturer to cast into the stream, to the injury of a lower proprietor, refuse from his sawmills, beyond the amount that is necessarily incidental to the running of his mills.[23]

In Vermont it is held that the discharging into a stream of sawdust and refuse from sawmills to the injury of proprietors below is governed by the rule of reasonable use.[24] In New York the same rule applies in regard to sawmill refuse;[25] and it is also there held that the defiling and discoloring of a stream by the discharge of dyes from a plush factory, even though no actual damage is

shown, is a ground for an injunction, since if not stopped the use might grow into a right by prescription;[26] and the pollution caused by the discharge of oil from machinery may be prevented.[27] So in Wisconsin and Indiana the pollution of waters by a starch or paper factory rendering them unfit for watering stock and ordinary domestic use will be enjoined at the instance of the lower owner who is damaged thereby; and in Minnesota unnecessary discharge of saw-dust will be enjoined.[28]

DISCHARGE OF SEWAGE BY CITIES AND INDIVIDUALS.

The right to an injunction and to damages on account of the discharge by cities and individuals of sewage into streams thereby polluting them so as to render them unfit for ordinary uses has been clearly established by the latest authorities. One of the leading cases upon this point was decided in New Jersey last year. A city of about 100,000 inhabitants emptied its sewage system into the Passaic river, which flows through the city of Paterson. Some lower proprietors, including a water works company, brought a bill for an injunction to restrain the pollution of the waters by the city. The court said:

> It is objected, also, that the defendant has the right to empty its sewers into the Passaic river, whatever the consequences may be. This contention rests in part upon the ground that it is a natural and reasonable use of the river, and in part upon the insistence that legislative authority to the city of Paterson to construct sewers contemplated their discharge into the Passaic, and impliedly authorized it. The sewage in question, it is remembered, is discharged into a stream above tide, and where the stream is not navigable. It does not naturally flow into the stream. It is gathered by the municipality of Paterson, in sewers, from numerous buildings, cesspools, culverts and drains, over a large area of land and by uniform, artificially constructed grades is gravitated to and discharged into the river. It is vastly more than the mere natural drainage of riparian owners. I cannot conceive of any tenable ground upon which such drainage can be classed as either a natural or reasonable use of the river.[29]

It was claimed by the city in that case that the city's charter allowed it to dispose of the sewage in this way. The New Jersey court denied such a construction to the statutes and expressly denied the constitutionality of any statute which would allow such pollution by a city, saying:

> The authority conferred is limited to mere construction of the sewers in accordance with the maps. It does not license either public or private nuisance through pollution of the waters of the river. As to private rights, I

need only say that they have constitutional protection against any such legislative enactment. In England, where the power of parliament is omnipotent in matters of this kind, both as to public and private rights, it is well settled that legislative authority to merely drain into a stream does not authorize the contamination of the water. Legislative license to create a public nuisance of the kind considered must be given in express terms, or by absolutely necessary implication. That the city of Paterson has any right to pollute the waters of the Passaic river by the discharge of its sewage into them is clearly an untenable proposition.[29]

It was also held that there was no laches on the part of the plaintiffs, because they did not make complaint when the discharge of sewage was begun, and that they were not obliged to take action until it was shown that the quantity and character of the sewage was such as to injure their rights.[29]

In Missouri it was held that while public statutes might be provided for the condemnation of the right of cities to discharge sewage into a stream to the injury of lower proprietors on the river, still such rights could not be obtained by a city without condemnation proceedings and damages properly paid. It was held that the discharge of sewage by a city was not a reasonable use of the stream. "A city has no right to gather its sewage altogether and cast it into a stream so as to injure the lower proprietor. For damages thus sustained, the lower proprietor would have an action and in many instances injunctive relief."[30]

Gould says:—

An authority over sewage is no authority to commit a nuisance. An owner of land upon a stream below a city is entitled to an injunction against injury by the outflow of sewage. So an injunction will lie to prevent the opening of additional sewers into a stream in such a manner as to render the water unfit for use, and it is not a defense that the city cannot lawfully enter upon the premises of those who use the sewer for the purpose of abating the nuisance. And if a few house-holders upon a stream have used it as a drain, a modern board cannot found a prescriptive right to corrupt the stream upon such usage. If any nuisance of this kind be shown, though causing inconsiderable damage, equity will enjoin its continuance. In deciding upon the right of a proprietor to an injunction against such a nuisance the court will not consider the convenience of the public. The fact that a large population will be affected by an interruption of the use of a system of sewers is immaterial where the rights of an individual are invaded. The inconvenience is one of the public's own creation, and should be borne by it rather than the individual. But where the nuisance is public, an individual is not entitled to an injunction unless he shows a substantial injury to himself. An injunction will be granted to prevent a local board from polluting surface-water flowing by an open gutter into a canal and supplying it with water, by first diverting it into a sewer and discharging sewage into the canal. So a city council will be restrained from discharging sewage into a

private canal. Where a discharge of sewage into a stream has been continued for several years, but in quantities not producing perceptible injury, and is afterwards increased so as to cause a serious injury, a party applying for an injunction against such increase will not be held guilty of laches.

In California, the city of San Luis Obispo discharged its sewage into the San Luis Obispo creek, which was a natural stream running through the corporate limits of the city, and from there ten miles, where it emptied into the Pacific ocean. An action was brought in the name of the people to restrain the discharge of the sewage as a public nuisance and an injunction was granted prohibiting the city from discharging its sewage into the creek.[32]

In the same state in 1897, it was held that an owner of land on a natural stream would be granted an injunction against the pollution of the waters of the stream by the turning in of sewage of a city above. The court said:

The pollution of water by the flow of sewage from towns or cities into streams, whose waters are thereby injured or rendered unfit for use, has frequently been a ground for the application for the preventive aid of equity by injunction. The doctrine is well established that the fouling or pollution of water in a stream by such sewage constitutes a nuisance and affords sufficient ground for relief by injunction. * * * The case then stands thus: Plaintiff as the owner of lands through which the water of Santa Rosa creek flowed had, and still has, a right of property in the waters of the stream. The right is a corporate hereditament, appurtenant to the land and running with it. Her right as a riparian owner was not only to have the water of the stream flow over her land in its usual volume, but to have it flow in its natural purity; and such pollution of the stream by the defendant as substantially impaired its value for the ordinary purposes of life, and rendered it measurably unfit for domestic purposes, is an actionable nuisance; and the fact that the defendant is a municipal corporation does not enhance its rights or palliate its wrongs in this respect.[33]

In Pennsylvania in 1894 it was held that a city could not discharge its sewage into a stream and cause injury to springs or lands below which were fed from the stream.[34] In Massachusetts it was held that a riparian owner will be granted an injunction to prevent a city from discharging sewage into his mill pond thereby causing deposits at the bottom of the pond and unhealthy gases to arise from the deposit. In the same case it was held that a city might acquire a prescriptive right so to discharge sewage, but that the extent of that prescriptive right would be limited to the amount and manner of depositing sewage for the full period required by the prescription laws, which is usually fifteen or twenty years. Any increase within the limit of the statute would not be covered

by the prescriptive right. It is also held that in case of granting such an injunction against a city, the latter would be allowed a reasonable time to readjust its works to the condition of affairs necessary to comply with the injunction.[35] It is also held that a city has a right to discharge ordinary surface drainage from the streets into a stream, except as prohibited by special legislative enactment.[36] The later holdings in Massachusetts are rather inclined to repudiate or at least limit the holding of a case decided in 1872, in regard to the city of Worcester, where a riparian owner below was refused damages caused by the pollution of waters by the discharge of sewage from the city of Worcester, and in which case it was held that a city was only liable for improper construction or unreasonable use of the sewers—the liability being placed upon the ground of negligence.[37]

The doctrine adopted in Massachusetts that a city may gain a prescriptive right to foul the waters of a stream with sewage is expressly repudiated by the Connecticut court and the grounds there stated for the refusal of such right seem to be conclusive. In 1897 it was held that a deposit of sewage by a city in a stream would be enjoined as a public nuisance, and that money damages would be allowed to a lower proprietor who had been injured thereby. It was also held that the pollution of a stream in the way indicated being in the nature of a public nuisance, no length of time can legitimate or enable a party to obtain a right to such pollution by prescription.[38] In the same state it was held that a lower riparian proprietor will be granted an injunction against a city from discharging any sewage into a stream above plaintiff's premises and from polluting the waters by any such discharge. The term "sewage," it was held, included refuse and foul matter, solid or liquid, which was discharged by the sewers into the stream; including such fluid portions as, if apparently innoxious when so discharged, might become, by combination with other substances found in the stream, the occasion of decomposition and consequent pollution. The fact that such an injunction might throw upon a city a heavy pecuniary burden was no ground for refusing the injunction.[39]

So in Illinois, a lower proprietor on a stream will be allowed an injunction against a city from discharging sewage into a stream, to his damage;[40] and the draining of a cemetery into the waters of a stream used for domestic purposes and for harvesting ice will be enjoined.[41] In New York it is held that a city will be restrained from discharging sewage into a river to the damage of proprietors

below, even if the sewer is not a public sewer and although it may have been built upon private property;[44] and the contamination of a natural water course by a city's sewage will be prevented by injunction and will entitle those injured to damages.[43] A leading English case on this point holds that where a city was turning sewage into a stream to the injury of a land-owner, the right of the land-owner to relief was the principal question to be considered, rather than the question of inconvenience to the defendant city. although the defendant represented a large population and would be seriously inconvenienced by being prevented from disposing of sewage in the way complained of by the plaintiff.[44]

OTHER SOURCES OF POLLUTION WHICH ARE ILLEGAL.

From the foregoing general statement of the law and its application in regard to manufacturing and mining companies and to sewage, it can be seen that it will apply to any kind of pollution or defilement of the natural waters of a stream or lake. Without enumerating all the various instances in which the rule has been applied, the following may be noted: The placing of a hog pen and cow stable near a stream so that the refuse of the stable is thrown into the stream;[45] the placing on the banks of a stream or near thereto of contaminating materials, which may be washed into or may drain into the stream;[46] the placing of a cesspool or manure or oil near the banks of a stream;[47] the discharging of heated water into a stream;[48] the discharging of chemicals or acids.[49] Other specific instances are mentioned by Gould.[50]

SOME POINTS INCIDENTAL TO THE ABOVE.

It is held in Utah that the law of riparian rights has never been recognized in that state and a statute ignoring the right of a riparian owner at common law to have the water in a stream flow in quantity and quality as it was wont to do when he acquired title, is valid;[51] but the defect seems to have been remedied to some degree by statutes which have made it a criminal offense to pollute streams used by a community for domestic purposes.[52]

Although held in Massachusetts that a prescriptive right to pollute waters may be obtained, it is held that under the condemnation acts a water works company could condemn such prescriptive right and thereby prevent all pollutions.[53]

Where an upper riparian owner on a stream by the unreasonable use of the stream pollutes it so that the water as it flows upon

the farm below is not only useless for stock and domestic purposes, but also is a source of sickness, pain and discomfort to the lower owner and his family, the latter is entitled to recover not only the difference in the rental value of the farm on account of the nuisance, but also such special damages as he may have suffered, including that resulting from sickness, pain and discomfort. This was said in a case where refuse from a slaughter house above was allowed to flow down the stream.[54] The same rule is laid down in the case of injuries occasioned by sewage from a city.[55]

A water works company is not in all cases liable for injuries caused by the furnishing of impure water. Such liability is based upon the question of negligence and it would be a defense to such an action that the complainant was guilty of contributory negligence. It is held in Wisconsin that under a franchise by a contract with a municipal corporation, a water works company, in distributing water for public and domestic use, is not responsible as an implied warrantor of the purity of the water distributed by it; but if such corporation knowing that it supplies impure water under circumstances such that its customers are liable to use the water in ignorance of the danger, and it is negligent in disclosing the danger, the company is liable for all injuries caused by such negligence. It was held in the same case that if a person drinks the water knowing, or under circumstances where he ought to know, that it was dangerously polluted, then he is guilty of contributory negligence.[56]

In a recent case it was also held that a city cannot, as a prerequisite to furnishing water from its public water supply, require a citizen to sign a contract releasing the city from its liability to supply water or from liability for supplying impure water.[57]

REMEDIES BY CRIMINAL PROSECUTION.

In addition to the right of remedy by civil action, there is also the remedy by criminal prosecution. In almost every state in the Union special criminal statutes have been enacted providing for penalties for the pollution of waters, and especially of waters which are or may be used for drinking purposes. As a general principle of criminal law, the pollution of running waters would itself be an indictable offense, especially where the pollution was a continued one. In such case it would amount to a "nuisance;" and most cases of defilement of waters, which would give a right of civil remedy, would come within the provision of the criminal laws

against the maintaining of a "nuisance." Indeed, it has already been seen that the very reason why in Connecticut it was held that no prescriptive right to the continuance of a means of pollution could be obtained, was that it was a public nuisance, and that no continuance of an act which was wrong in a criminal sense could give a prescriptive right.[38] Of course the particular form of prosecution, or perhaps whether any criminal prosecution could be maintained at all, depends upon the criminal laws and statutes of the jurisdiction in which the offense is committed. But the right of the legislature to provide against pollution and defilement of streams by special criminal statutes cannot be doubted. In Massachusetts a statute provides:

> No sewage, drainage or refuse or polluting matter, of such kind and amount as either by itself or in connection with other matter will corrupt or impair the quality of the water of any pond or stream hereinafter referred to, for domestic use, or render it injurious to health, and no human excrement shall be discharged into any pond used as a source of water-supply by a city or town, or upon whose banks any filter basin so used is situated, within twenty miles above the point where such supply is taken, or into any feeders of such pond or stream within such twenty miles.[58]

So in Utah the principles of the common law are to some extent re-established by statutory enactment.[52] In California the pollution of waters by the corralling and housing of sheep on the borders of a stream is prohibited.[59] And in Louisiana the right of the legislature to regulate the dumping of refuse, garbage, night soil, dead animals, etc., in large navigable rivers is clearly upheld with reference to the casting of offal into the Mississippi river.[60] And in Indiana it is held that a navigable river is a "public place," and that a pollution of the waters in such navigable river is indictable as a nuisance.[61]

In the United States federal courts of Indiana it was held that a court of equity will enforce the right of a private riparian owner or of a public water company to have the water of a stream flow past its lands unpolluted. Such pollution by an upper proprietor, even for manufacturing purposes, is a public nuisance and as such may be enjoined or abated. Such pollution is also forbidden by the criminal statutes covering nuisances, and is therefore generally indictable.[62]

The same finding was later affirmed by the same court and it was held that as against the right of a riparian proprietor to have the water flow in its natural purity, there is no public policy in favor of industrial development which will justify the erection and operation of a factory that pollutes the stream.[63]

If the pollution affects the public, as by the destruction of fish in a public river, or by placing the carcass of a dead animal in a pond or river, or urinating in a spring near a highway, from which persons in the vicinity and travelers upon the highway are accustomed to drink, it is the subject of a public prosecution. If a business is so conducted as not only to foul adjoining streams but also to dangerously taint the atmosphere passing over adjacent highways and the entire neighborhood, a suit therefor by one neighboring proprietor is not an action to abate a private nuisance, but a private action to abate a public nuisance. A statute which prohibits the pollution of a supplying stream is not complied with by polluting and purifying its waters before they reach the storage reservoir. A person cannot justify as agent for another in maintaining a public nuisance; and the fact that persons have come to live within the scope of a nuisance after its creation does not prevent their complaining of it.[64]

Without enumerating other special statutory provisions, it is safe to say that any statutory enactment which is made to enforce the principles of the law against pollution, whether it be in lakes, in private streams, or in navigable rivers, and which forbids the dumping into rivers of refuse or offal, or injurious substances of any kind, would be valid and enforcible, and that such statutes already exist in most states of the Union.

But independent of special statutory provisions, there is in most cases of pollution a remedy by indictment. The right of the individual and of the public to have flowing water remain unpolluted by any artificial means is a common law right and the violation of that right, so as to cause serious inconvenience to the public, is an indictable offense under the rules of the common law.[65] Indeed, at the common law an offender was not only liable to conviction, but in the same proceedings the court could, by proper decree, order and direct the nuisance to be abated forthwith, and at the cost of the defendant.[66]

In most jurisdictions, there is also a remedy by special proceedings which can be brought in the name or in behalf of the people for the abatement of the nuisance, and any structure or course of conduct which causes the pollution of the flowing stream to the serious injury or inconvenience of the public, and especially when that renders the stream unfit for domestic purposes, may be abated under proper proceedings brought for that purpose. The rule is the same in navigable streams as it is in private or non-navigable streams.[67] The fact that a stream is navigable and is necessarily used by individuals and navigation companies for the purposes of navigation, gives no right to such users to befoul the stream. The public and individuals have a right to use the waters of a public, navigable stream in its pure state; and a person or navigation com-

pany casting or throwing offensive matter into a navigable stream is liable not only to indictment, but is also liable in damages to any individual particularly injured thereby.[68]

In civil and criminal cases, of course the question often arises as to the public convenience in the discharge of its sewage. But it has been expressly held in most of the cases that even if there is no other method by which sewage can be disposed of except to discharge it into a running stream, that fact will not justify a town or city in discharging it into a stream to the injury of lower owners. It makes no difference that the town is large and that the number of persons to be affected by the nuisance may be few.[69] It also makes no difference how far the contaminating matter is carried. When it has been established that the injuries of the party complaining are caused by the acts of the defendants, the right of action is established.[70]

REMEDIES AS BETWEEN DIFFERENT STATES AND DIFFERENT COUNTRIES.

On account of the nature of the subject, questions of civil remedies and of criminal prosecution on account of injuries by the pollution of running waters oftentimes involve questions of interstate and international law. While few cases involving these points have arisen directly in instances of pollution, the general principles of the law in regard to the rights upon boundary and border streams are well settled and the possible questions in regard to cases of pollution have necessarily been settled at the same time.

It may be stated as a general proposition that where the acts causing the pollution are done in one jurisdiction and the injuries suffered in another, whether the jurisdictions are those of different states of the Union, or of different countries, there is a well settled right in the injured party to have his remedy in a civil action, to the same extent that would exist as if he were a citizen of the jurisdiction in which the act of pollution is committed. As I have already pointed out, the remedy by criminal prosecution depends somewhat upon the peculiar statutory enactments which exist; but in most instances the non-resident injured party has open to him also a remedy by prosecution in the criminal courts.

The placing of filth and offal into a river in one county by which the waters are polluted in another county is indictable in either county.[71] On the same principle a discharge of refuse in one state which causes pollution in another state may be indictable in the

state in which the injury is suffered.[72] This is on the principle, as stated by the Arkansas court, that "it is not necessary in all cases that a man should be actually present in this state to make him amenable to our laws for the crime committed here. If the crime is the immediate result of his act, he may be made to answer for it in our courts, though actually absent from the state at the time he does the act, because he is constructively present, or present in contemplation of law. For example, if a man standing beyond our boundary line in Texas, were, by firing a gun or propelling any other implement of death, to kill a person in Arkansas, he would be guilty of murder here, and answerable to our laws, because the crime is regarded as being committed where the shot or other implement propelled takes effect."[73]

It was held by the United States circuit court in Montana in 1898, that a diversion of waters in Montana from a stream which flowed into Wyoming and by which diversion the legal rights of appropriators in Wyoming were affected, would be prevented. It was claimed that the citizens of Montana had diverted water only in Montana. This was in a case of a private stream. It was held that it was a mere question of private rights between individuals; that the lower proprietor had a right to have all the water come down to him, subject to vested rights under the laws of congress, and that no international water right question in the case of the appropriation of the waters of a non-navigable stream could arise; and it was held that the Wyoming lower proprietor could enforce his rights in the United States circuit court of Montana.[74]

A party who commits a nuisance in or upon the waters of a river flowing between two states or from one state to another so as to injure parties in the adjoining states, who have a right to the use of the stream, can be enjoined or prosecuted in the state courts of the state where the nuisance is committed or in the United States courts for the district in which the nuisance is committed. In such cases the law governing the case is that of the district or state in which the action or prosecution is brought.[75]

In a Rhode Island case the complainants were citizens of Connecticut who owned land and a mill on the Pawkatuck river on the boundary line between Connecticut and Rhode Island. The Rhode Island riparian owners diverted more than their undivided half of the water. It was held that the Connecticut parties might sue in the Rhode Island courts for an injunction and for an abatement of the nuisance and that they could also proceed against the defendants in Rhole Island under the criminal laws of Rhode Island for

the maintenance of a nuisance, although the injury was suffered in Connecticut. It was held that *a fortiori* could the complainants prosecute the defendants in a civil action for damages for the injuries done, and that the complainants' action for an injunction would lie. In deciding the case it was said:

> I can conceive of crimes, likewise like civil injuries, which may be prosecuted in two states, though sometimes in different forms, at least, as here. Such is the case of theft continued from one state to another, or the felonious intent indicated in both, or a burglary in one state being a larceny in another, where the property was removed, but no house broken into. So if one fires a gun in one state which kills an individual in another state, there may be the offense of using a deadly weapon in the first state and committing murder by killing in the second state. Again, there is sometimes an election in which to prosecute. Thus, if a blow be given in one county and death follows in another, an appeal of murder lies in either. If two acts are necessary to constitute an offense and one is done in one county and one in another, the prosecution may be in either. So if A in one county injure land in another. So if one in the state of Ohio draws a bill to defraud and send it to New York by another, and thus commit or complete the fraud there, he can be punished there. And to remove all doubt by a reference to a case almost identical with this in principle, "if a man doth not repair a wall in Essex which he ought to repair, whereby my land in Middlesex is drowned, I may bring my action in Essex, for there is the default, or I may bring it in Middlesex, for there I have the damage."[76]

So where A diverted in Connecticut a stream of water so that it ceased to flow to B's mill situated on the same stream in Massachusetts it was held that the circuit court of the United States for Connecticut had jurisdiction of an action brought by B against A for diversion. The case was compared to a case where a party owned a dwelling house in Massachusetts which he was accustomed to rent, and a party had published in Connecticut a malicious libel in regard to the dwelling house in consequence of which it had been greatly impaired in value; it was held that in such case the injured parties could have their redress in Connecticut, and did not have to wait until they could find the defendant in Massachusetts so that he could be served with process.[77]

One of the leading cases upon this subject is an Ohio case decided in 1848, in which it was held that a diversion of water in Pennsylvania, occasioning damages to property in Ohio on the same stream, gave a right of action which could be maintained in Ohio, and it was further held that such action might be maintained either in Pennsylvania or Ohio.[78]

In a Wisconsin case in 1879, it was held that injuries on a stream occasioned by a dam would be ground for a criminal prosecution in

the jurisdiction in which the dam existed; and that it would give a right of civil action for damages in either jurisdiction.[79]

A statute in Maine provided that where damages were suffered by lands being overflowed by a dam, the remedy should be by a complaint to obtain compensation, and that no common law action for damages for overflow could be sustained. Defendants, citizens of New Hampshire, built a grist mill in New Hampshire on the Salmon Falls river, by which the plaintiff's mill on the tributary above, which was wholly situated in Maine, was damaged by backflow. It was held that the statute referred to applied only to injuries caused by obstructions or nuisances maintained in the state of Maine, and that under the circumstances the plaintiffs could maintain a common law action for an injunction and damages.[80]

As a general principle a civil action for a tort is a transitory action, and it may be brought in any jurisdiction where service can be obtained upon the wrong-doer. The civil action for damages by diversion or for damages by pollution is such an action and would be sustained in any court where jurisdiction of the person of the defendant could be obtained. This is shown from the above authorities; and the rule is even extended to some rights of action which did not exist at common law, but which are given by statute, such as for instance the right to recover damages against a railroad company arising from the negligence of a fellow servant.[81] Crimes may be committed in one state by a person who is not in that state. This is true in all cases where the moving agent or instruments or means used produces the criminal results in another state.[82] This rule covers not only crimes against natural law, but also many statutory crimes, especially those which would be classified as *malum in se*—including all forms of wrongful pollution. In such cases the criminal prosecution may be had in the state in which the injury is done, although occasioned by acts committed directly by the principal in another state.

Substantially the same rule holds as to cases arising between different countries. Under the principles already set forth, it will be seen that there is an adequate remedy for damages caused by pollution on boundary rivers and upon rivers flowing from one country into another, so far as civil actions for damages are concerned, and to a large extent also so far as the right to a criminal prosecution is concerned.

In case the courts of a neighboring country or government refused to recognize the principle of the right of riparian owners to have the water of streams come to them substantially unchanged,

either in quantity or quality, it would then be a matter simply of diplomatic interposition, to be adjusted according to the law of nations and the comity which exists between nations. Questions of a similar character have been taken up and decided by treaty. Prior to 1795 citizens of the United States had been prevented from navigating the Mississippi river through the domains of the Spanish government at the mouth of that river. The United States government interposed, claiming that the right of navigation was a natural right, and the Spanish government acquiesced in such view in the treaty of 1795.[83] Again, in 1826, our government attempted to have the same question decided in regard to the navigation of the St. Lawrence, but the British government refused to recognize the natural right claimed by the United States, which denial has been severely criticised. However such denial was based principally upon reasons of policy which could not exist in a case of an attempt to prevent injurious pollution of border streams.[83]

In a Texas case a Mexican owning property on the south bank of the Rio Grande river in Mexico was injured by obstructions placed in the bed of that river by an American in Texas. It was held that the Mexican could bring suit in Texas. The court said that "in such cases even by the technical rule of common law, the action may be maintained either in the jurisdiction in which the act was committed, or in that in which the injury was sustained," and that to refuse such a remedy would be to refuse "to observe the constitutional pledge promising a remedy by due course of law for injury done, in lands, person or reputation, as plainly as if it refused a remedy for an injury inflicted in a foreign jurisdiction to one's goods or person."[84]

A party doing an injury in one jurisdiction to a water power or water right running into another jurisdiction, may be proceeded against in civil suit in either jurisdiction which he may be served with process; though proceedings in rem by way of injunction or indictment to compel abatement, can only be brought in the jurisdiction in which the nuisance exists.[85]

In 1880 complaint was made to the United States government that Mexicans engaged in agricultural pursuits on the Mexican shore of the Rio Grande river were in the habit of diverting the water coming down the river into ditches, thereby preventing the American citizens on the north side from getting sufficient water to irrigate their crops. Secretary Evarts considered that the mat-

ter was one which was properly the subject of diplomatic intervention and said, in regard to the action of the Mexicans:

This if true would be in direct opposition to the recognized rights of riparian owners, and if persisted in must result in disaster and ruin to our farming population on the line of the Rio Grande and might eventually, if not amicably adjusted through the medium of diplomatic intervention, be productive of constant strife and breaches of the peace between inhabitants of either shore.

Further referring to the action of the Mexican citizens, Secretary Evarts said:

This is not only in direct opposition to the recognized rights of riparian proprietors, but is also contrary to that good feeling and harmony which ought to exist between co-laborers in peaceful pursuits, and might, moreover, if permitted to continue, result in bitter feeling and possible breaches of the peace.[86]

In 1884 the inhabitants of New Brunswick erected works on the Meduxnikik river so as to obstruct the flow of water in Maine and to injure the lumber business in that state, and Mr. Frelinguysen, the then secretary of state, in a letter to Mr. Lowell, the minister to Great Britain, held that the wrong was a proper subject for diplomatic interposition by this government.[87]

The principles governing the right of civil remedies and of criminal prosecutions which are above set forth for injuries occasioned by diversion and other wrongs on streams which are boundary line streams or which flow from one state into another or from one country into another, would in all interstate and international cases govern the right of civil remedy and criminal prosecution for the pollution of streams.

Without attempting a resume of all the conclusions deducible from the authorities above cited, it will be clearly seen that the right of the individual and of the public to have the natural waters of streams and lakes remain undefiled by any artificial means is so universally established that there is always open to the party injured a speedy remedy, both in the civil and in the criminal courts. Whenever proper and prompt remedy seems to be lacking, such deficiency may readily be supplied by vigorous legislative enactments directed at specific sources of pollution. Such legislation, so long as it is general in its application, is and would be of undoubted validity and would be promptly enforced by the courts, not only as founded upon sound principles of law, but as pursuant to a sound public policy.

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4 3 Kent Com., 439.
5 Water Co. vs. Water Board, 168 U. S., 349.
6 Washburn Easements, Sec. 11, page 317.
7 Angell on Watercourses, Secs. 136, 137, 140b, 140d.
8 Angell on Watercourses, Sec. 450a.
9 High on Injunctions, Sec. 805.
10 High on Injunctions, Sec. 810.
11 Gould on Waters, Sec. 219.
12 Sanderson vs. Coal Co., 86 Pa. St., 406; 94 Pa. St., 303; 102 Pa. St., 370; 113 Pa. St., 126.
13 Elder vs. Coal Co., 157 Pa. St., 490; Hindson vs. Markle, 171 Pa. St., 138.
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16 Beach vs. Sterling Iron Co., (N. J. 1895) 33 Atl., 286; 54 N. J. Eq., 65; Holsman vs. Bleaching Co., 14 N. J. Eq., 335; Higgins vs. Water Co., 36 N. J. Eq., 538; 55 N. J. Eq., 824; Sterling Iron Co. vs. Mnfg. Co. (1897), 38 Atl., 426.
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26 Townsend vs. Bell, 17 N. Y. S., 210; Townsend vs. Bell, 24 N. Y. S., 193.
27 Covert vs. Cranford, 141 N. Y., 521; Smith vs. Cranford, 32 N. Y. S., 375.
28 Middlestad vs. Starch Co. (Wis.), 66 N. W., 713; Muncie Pulp Co. vs. Martin (Ind.), 55 N. E., 796; Roller Mills vs. Wright, 30 Minn., 254.
29 Attorney General vs. City of Paterson, 42 Atl. (N. J. 1899), 752.
30 Mining Co. vs. City of Joplin (Mo. 1894), 27 S. W., 406; Locks & Canals vs. City of Lowell, 7 Gray, 223; Haskell vs. City of New Bedford, 108 Mass., 208; VanMills vs. Nashua, 63 N. H., 136; Chapman vs. City of Rochester, 110 N. Y., 273.
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32 People vs. City of San Luis Obispo, 116 Cal., 617.
33 Peterson vs. City of Santa Rosa, 51 Pac. (Cal.), 557.
34 Good vs. Altoona City, 162 Pa. St., 493.
35 Middlesex Co. vs. Lowell, 149 Mass., 509.
36 Brainard vs. Newton, 154 Mass., 255.
37 Merrifield vs. Worcester, 110 Mass., 216.
38 Nolan vs. New Britain, 69 Conn., 668.
39 Morgan vs. City of Danbury, 67 Conn., 484.
40 Robb vs. Village of LaGrange (1895), 158 Ill., 21.

41 Barrett vs. Cemetery Ass'n, 159 Ill., 385.
42 Stoddard vs. Village of Saratoga Springs, 4 N. Y. S., 745.
43 Butler vs. Village of Edgewater, 6 N. Y. S., 174; Chapman vs. City of Rochester, 110 N. Y., 273.
44 Attorney General vs. Council of Birmingham, 4 Kay & J., 528.
45 People vs. Elk River Lumber Co. (Cal.), 40 Pac., 486; People vs. Elk River Lumber Co., 40 Pac., 531.
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53 Martin vs. Gleason, 139 Mass., 183.
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55 Randolf vs. Town of Bloomfield, 77 Ia., 50; Loughran vs. City of Des Moines, 72 Ia., 384.
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60 Witham vs. City of New Orleans, 49 La. Ann., 929.
61 State vs. Wabash Paper Co. (Ind.), 51 N. E., 949.
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64 Gould on Waters, Sec. 219.
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71 State vs. Herring (Ind. 1897), 48 N. E., 598; State vs. Wabash Paper Co., 48 N. E., 653.
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73 State vs. Chapin, 17 Ark., 561.
74 Howell vs. Johnson, 89 Fed., 556.
75 R. R. Co. vs. Ward, 2 Black, 485.
76 Stillman vs. Mnfg. Co., 3 W. & M. (R. I.), 546.
77 Foot vs. Edwards, 3 Blatch. C. C. Rep., 310.
78 Thayer vs. Brooks, 17 Ohio, 489.
79 In re Eldred, 46 Wis., 530.
80 Worcester vs. Mnfg. Co., 39 Me., 246.
81 Herrick vs. M. & St. L. Ry. Co., 31 Minn., 11.

82 Rorer Interstate Law, 241-3; Adams vs. People, 1 N. Y., 173; Thayer vs. Brooks, 17 Ohio, 489; State vs. Ellis, 3 Conn., 185; State vs. Wyckoff, 31 N. J. L., 65; State vs. Moore, 26 N. H., 448; State vs. Grady, 34 Conn., 118; Johns vs. State, 19 Ind., 421.

83 Pomeroy International Law, page 145; 1 Phillimore International Law, page 167.

84 Armendiaz vs. Stillman, 54 Tex., 623.

85 1 Wharton's International Law Digest, Sec. 20.

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87 1 Wharton's International Law Digest, Sec. 21.

July 10, 1900.

ADDITIONAL NOTES ON THE LAW OF POLLUTION.

Since the above paper was published in July, 1900, the legal questions bearing upon the pollution of waters of streams and lakes have arisen in many litigated cases. During the past three years attention has been more than ever given by state legislatures, state boards of health and individuals to the prevention of pollution; and cases bearing upon this question have been before nearly all of the courts in the United States, both federal and state. It is interesting to note that the trend of these recent decisions is to a strict application and enforcement of the principles of law in regard to pollution which are outlined in the above paper. The experience of the past three years in these cases has shown that, as before stated, there is no principle of law which seems to be so well founded and so little susceptible of change and which there is so little liability of the failure of the courts to recognize, as the principle that people have a right to have the waters of lakes and streams kept undefiled for the natural uses to which they are adapted.

Without entering again into a discussion of the source or reason for the rules which have been laid down, I will here add a few notes as to the more important decisions rendered during the past three years upon the subject, citing the cases as they are referred to.

The case of *Attorney General vs. City of Paterson,* above referred to (note 29), was carried to the court of errors and appeals in New Jersey, and there, in the year 1900, the decision above cited was substantially affirmed. The New Jersey appellate court held that riparian owners upon the Passaic river, at points where the tide ebbs and flows, had no right to enjoin the city of Paterson from polluting the river with sewage at those points, as against a legislative grant which in terms allowed the city so to do. However, it was held that such a pollution of the river by sewage above tidal points

constituted a taking of property of riparian owners, which a legislature cannot authorize, except upon making just compensation; and it was held that such riparian owners had a right to damages, and, if the pollution were continued, to permanent compensation, and, in case the city complained of, did not take proceedings to condemn, and to make compensation, a permanent injunction would be allowed against it. This was in a case where a very expensive sewage system had been constructed and placed in operation for discharging the sewage into the river in the manner complained of. *Attorney General vs. Paterson, 45 Atl. Rep. 995; also Mayor of Newark vs. Seyre, 45 Atl. Rep. 985.*

The ground of the distinction in the last case cited might appear, from the decision, to be that where the tide ebbs and flows the riparian owner does not own the bed of the stream, but only owns to high water mark, and that above points affected by the tide, no matter what be the size of the stream, the riparian owner owns the bed of the stream, which is the rule of riparian ownership in New Jersey. This is the old distinction as to riparian ownership which has been adhered to in many eastern states but which has not been recognized in many inland states with reference to public or navigable streams. Here in Minnesota, for instance, riparian ownership on public or navigable streams, although far away from any possible tidal flow, extends only to ordinary high water mark, with a qualified fee extending to low water mark; and the title to the bed of the stream rests in the state. *Schurmeier vs. R. R. Co., 10 Minn. 82; Depot Co. vs. Brunswick, 31 Minn. 297; Hanford vs. R. R. Co., 43 Minn. 104; see also The Genesee Chief, 12 How. 443.* But it would be a mistake to argue from the New Jersey case that a city, either with or without legislative authority, could, in the inland states referred to, pollute the waters of a public or navigable stream to the injury of riparian owners. Whatever may have been held to be the right of the state to authorize the discharge of sewage or other polluting matter into tidal waters, or waters affected by the tide, the right of riparian owners upon lakes and streams above tide waters to use the waters and have them kept undefiled by artificial means is the same in all states, independent of any differences in the rule as to the point to which the riparian owner's ownership in the bed technically extends.

The right of individuals and the public to have the waters of all streams remain undefiled is shown by the decision of the United States Supreme Court in the so-called "Chicago Drainage Cases", in which it was decided that the construction by a public corpora-

tion, as an agency of the state, of a system of public works to promote the health and prosperity of its inhabitants, but which injures the health and prosperity of the inhabitants of another and adjacent state, (1) furnishes a sufficient basis for a controversy between the states of which the Supreme Court of the United States can take original jurisdiction, and (2) entitles the injured state to maintain a suit for equitable relief, even in advance of any actual injury sustained. It was further held, (3) that no matter how elaborate or expensive the public improvement was which caused the pollution, delay in bringing the proceedings for its prevention does not bar the right to relief. This was in the famous contention between the states of Illinois and Missouri with reference to the discharge by Chicago of its sewage through the Illinois river into the Mississippi river above St. Louis. This case came up upon demurrer and in the decision referred to all the principal questions of law were decided. Testimony is now being taken upon the question of fact, as to whether there is actually a pollution at the points complained of. *Chicago Drainage Cases (decided in 1901), 180 U. S. 208; also 35 American Law Review, 453.*

In Michigan it was decided in June, 1902, that, while ordinary bathing by the riparian owner himself in a stream was consistent with his right to a reasonable use thereof, and no wrong against a city below which used the water of the stream for its public water supply, still it would be beyond the rights of reasonable use for an upper proprietor to convert his property into a summer resort and allow a large number of people to come to his premises for the purpose of bathing, and that such use would be restrained in a suit brought by a city taking its water supply below. *People vs. Hurlburt, 91 N. W. Rep. 211.*

In Connecticut it was held that a city is responsible for the acts of its board of sewer commissioners, who use a stream for drainage; and that such use is unreasonable; and that no right of pollution can be acquired by prescription; and that even a riparian owner below could complain of damage to his property at that point, although he had a residence in the city complained of, with its drain emptying into the city drain. *Platt Bros. & Co. vs. City of Waterbury, 72 Conn. 531; reported with notes on "Right of Municipal Corporation to Drain Sewage into Waters," 48 Lawyers' Reports Annotated, p. 691.*

Within the present year it has been held by the appellate courts in New York, Alabama and Maryland that neither a city nor an individual can, even with legislative authority, discharge sewage

into streams to the injury of the rights of lower owners; that it is no defense that some other city on the same stream is doing the same thing and that the city complained of is only responsible for part of the damage; and that no right of pollution can be acquired by prescription; and that so long as the complaining party did not actually induce the construction of the sewage system complained of, it is no bar to relief that he did not complain until the system was actually put in operation and it is demonstrated that actual injury results. *Sammons vs. City of Gloversville (N. Y.), 67 N. E. Rep. 622; Birmingham vs. Land (Ala.), 34 So. Rep. 613; West Arlington Improvement Co. vs. Mt. Hope Retreat (Md.) 54 Atl. Rep. 982.*

One older case, which might well have been cited in the above paper, holds that one who maintains a vault so that with his knowledge filthy water habitually filters from it, whether above or below the surface of the ground, into the land of a neighbor, where it injures a cellar or well, is liable in damages for the injury, without other proof of negligence. *Ball vs. Nye, 99 Mass. 582.*

Other recent decisions, in which the general principles of the law against pollution as above set forth are sustained, are as follows: *Watson vs. Town of New Milford, 72 Conn. 561; Butler vs. Village of White Plains (N. Y.), 69 N. Y. Supl. 193; City of Jacksonville vs. Doan, 145 Ill. 23, and City of Mansfield vs. Hunt, 19 Ohio Cir. Ct. Rep. 488,* in which cases it was decided that where a city is complained of for discharging sewage into a stream, it cannot escape liability by showing that others contribute to the injury by like pollutions; *Weston Paper Co. vs. Pope (Ind.), 57 N. E. Rep. 719,* in which case it was held that the fact that the party complained of has built an expensive sewage system and conducts it in a careful manner without malice is no defense to an action for damages for pollution, and that it is no defense that others contribute to the pollution; *Mann vs. Willey (N. Y.), 64 N. Y. Supl. 589,* where it is held that even without actual damage a riparian owner is entitled to an injunction against the pollution of a watercourse, since he has a right to the water in its natural purity, irrespective of the question of user, and also that an order of a town board of health requiring the defendant to discharge sewage from his hotel into a watercourse is no defense to a suit by a riparian owner to enjoin such pollution, since the board of health has no power to authorize one citizen to maintain a nuisance to the injury of another; *Strobel vs. Kerr Salt Co., 164 N. Y. 303,* where it was held that a salt manufacturer could not render a stream salty to the injury of lower riparian owners whose rights cannot be abridged by the convenience

or necessity of the business of an upper riparian owner; *Mason vs. City of Mattoon, 95 Ill. App. 525, and Keppel vs. Lehigh Coal Co., 200 Pa. 649,* where the right to an injunction against pollution is maintained; *Board of Health vs. Diamond Mills Paper Co. (N. J.), 53 Atl. Rep. 1125,* where it is held that under a statute authorizing a board of health to enjoin the pollution of a stream by the discharge of sewage or other polluting matter into it, such injunction is authorized at the suit of the board of health if polluting matter is placed in the stream, although it does not actually pollute the water at the point where it is taken out for public supply.

Other recent interesting leading cases in point are: *Muncie Pulp Co. vs. Martin, 23 Ind. App. 558; Smith vs. City of Sedalia, 152 Mo. 283; Owens vs. City of Lancaster, 193 Pa. St. 436; Trevett vs. Prison Association of Virginia (Va.), 36 S. E. Rep. 373; City of Antonio vs. Rivas (Tex.), 57 S. W. Rep. 855; Gale vs. City of Syracuse (N. Y.), 71 N. Y. Supl. 986; Hollenbeck vs. City of Marion (Ia.) 89 N. W. Rep. 210; Stevenson vs. Ebervale Coal Co., 201 Pa. 111; Schumacher vs. Shawhan, 93 Mo. App. 573; Umschied vs. City of San Antonio (Tex.), 69 S. W. Rep. 496; State vs. Glucose Sugar Refining Co. (Ia.), 91 N. W. Rep. 794; Doremus vs. City of Paterson (N. J.) 52 Atl. Rep. 1107; Todd vs. City of York (Neb.), 92 N. W. Rep. 1040; Mining Co. vs. Mills (Montana), 94 Fed. Rep. 909.*

ROME G. BROWN.

Minneapolis, Oct. 1, 1903.

COMMERCIAL POLLUTION OF WATER SUPPLIES.

STARCH FACTORY REFUSE, HARRIS, MINN.

A complaint was made to this office relative to the pollution of Goose creek from the discharge of the starch factory at Harris. The complainants were farmers living on the stream below the factory. Mr. O. C. Peterson made an inspection of this creek May 31, 1900, and reported as follows:

"I examined the creek immediately above and at several points below the factory. The stream is a small one, from four to ten feet wide. Just below the factory it was quite free of any refuse, due, I was told, to the fact that the owner of the factory had had the creek cleaned out for some distance. At points which I examined about one, two and three miles below the factory, the potato gratings and refuse lie in great masses in all quiet places along the

stream, and wherever there is anything to obstruct its free passage. This refuse seemed to cover the whole bottom of the creek, and at some places seemed to be three or four feet deep. It had a very decided odor. The farmers complain that their cattle and horses refuse to drink the water, or are made sick by drinking the same. It is further stated that soon after the factory commenced operating this spring the fish in the stream died. I saw no evidence of fish, dead or alive, but was told that near the mouth of the stream hundreds of fish were lying dead on the banks.

"Unless the stream is dredged out, it will require some time for an improvement to be brought about by natural process of flowage or decomposition, as the stream is in places literally filled with potato gratings and yeasty masses, which, I am informed, were not even dislodged entirely by the high waters of last spring.

"Above the factory the stream is clear and the water apparently pure.

"The factory closed May 15th. It will be opened up again for business about October 1st."

BEET SUGAR FACTORY, ST. LOUIS PARK, MINN., APRIL 19, 1902.

A complaint was made to this board relative to the condition of Minnehaha creek at Edina Mills, alleging that the stream received pollution from the beet sugar factory at St. Louis Park. Complaint was also made by the Minneapolis Park Board and the Board of Directors of the Washburn Home relative to the general pollution of Minnehaha creek. Major Hale, representing the Washburn Home, Mr. Harry Jones, representing the Minneapolis Park Board, and Dr. H. M. Bracken, representing the State Board of Health, were met at the factory, for an inspection of the premises, by Mr. Douglas Fisk, the company's attorney, and Mr. G. W. Fink, its manager. Mr. Fink explained to us thoroughly the conditions as they now exist, and also conducted us about the premises. After a thorough inspection, all three of the parties above named representing complainants were satisfied that if there was any present pollution of Minnehaha creek from St. Louis Park, it must be from other sources than the sugar factory. It is undoubtedly true that in the early history of this factory there was pollution of the stream, for the waste molasses was allowed to discharge into the stream, but this molasses is now collected in two reservoirs, each having a capacity of 300,000 gallons, and is finally shipped to Michigan and Kentucky. At present there are two bodies of waste water from the factory, one of which may contain some contamina-

tion. This flow of water is conducted over a sandy soil in a low place and is disposed of by natural filtration. Undoubtedly a large proportion of this filtered waste water re-enters the shallow wells, plenty of which are located near by, and is again pumped into the factory water receptacles. The other stream of waste water is absolutely pure when it leaves the factory, for it is the product of distillation. This distilled water is used for washing the beets, and, as it leaves the same, carries nothing but the soil that has been washed off. This muddy water is discharged into settling tanks, of which there are five near the factory. Finally, this water, as it leaves these settling tanks, passes through a ditch over brush and stone placed there for the purpose of collecting any floating debris, such as leaves, etc., that has not been separated from the waste by sedimentation.

The sugar factory depends for its water supply upon twenty shallow wells and one artesian well, 1,000 feet deep. During the "season" (100 days) two and a half million gallons of water are used at this factory each day. The artesian well has a capacity of one and a half million gallons a day. The company owns about forty acres of land in connection with its plant.

Mr. Fink, the manager, who owns a large part of the company stock, impressed all of us as a man who was particularly anxious not to give occasion for complaint as bearing upon the waste water from this factory. It does not seem practical or necessary to require this company to make sewer connections with the Minneapolis sewerage system at the present time.

The beet pulp from this factory is deposited on dry land and is carried away by farmers as feed for stock. It does not come in contact with the waste water.

Mr. Fink was advised that during and immediately following the factory season the waters of the Minnehaha creek would be watched closely for a possible pollution from the factory. With this proposition he was quite satisfied and requested that if any pollution was noted, he be informed promptly of the fact.

In order to give the possible pollution of Minnehaha creek by the beet sugar factory at St. Louis Park a thorough hearing, parties representing Edina Mills and the sugar factory appeared before the Minnesota State Board of Health at its regular meeting April 22, 1902. The parties from Edina Mills claimed that in time past the water of Minnehaha creek was unfit for the cattle to drink, and that the fish died in the stream below the sugar factory. The parties representing the factory stated that when the plant was

first started it was permitted to discharge its waste water into the creek. They admitted that at this time there was probably pollution of the stream, but stated that as soon as complaints were made relative to such pollution, attempts were made to remedy the condition complained of.

It is possible that some of the pollution of the Minnehaha creek may come from other sources at St. Louis Park than the sugar factory, as there are other manufacturing plants in the suburb, or from dairy barns along the stream.

POLLUTION OF WATER BY DEAD FISH.

Many complaints are made every spring to the effect that dead fish collect upon the shores of certain shallow lakes throughout the state. Little, if anything, can be done to remove the cause of such complaints. In most instances the cause is a natural one due to the destruction of the fish in the lakes by process of freezing or smothering by ice during the winter season. In certain instances it is claimed that dead fish collect upon the lake shore for some time after the ice has entirely disappeared, and this was notably true at Waterville, Minn.

It was also claimed at this point that the lake was overcrowded with bullheads, and that as a result of such overcrowding, many died in the struggle for existence. At this place there were numerous fishermen who were quite willing and anxious to catch the bullheads in order to save them from dying a natural death, and they appealed to the game and fish warden for permission so to do. They assured him that bullheads did not come under the class of game fish, and that they would catch nothing but bullheads. Dr. Cory, the health officer of Waterville, requested the secretary of the State Board of Health to go before the Game and Fish Commission July 27, 1901, with parties from Waterville, to urge that the request referred to be granted. This he did, but as the conditions were unfamiliar, except as stated by the complainants, he refrained from speaking. Later he advised Dr. Cory by letter that if the nuisance was apparent again he would have the matter investigated and would then know how to advise in the matter.

The same day that the above parties went before the Game and Fish Commission (July 27th) Mr. O. C. Peterson, from the office of the State Board of Health, was making an inspection of the lake at Waterville. He saw little evidence of dead fish and encountered no unusual offensive odors during his tour of inspection. He saw

several fishermen on the lake, some of whom had caught more than a bushel of bullheads that day. He was informed that early in June the low water in the west end of the lake was filled with tons of dead fish, and that until they were raked into a trench along the shore and buried, residents near the lake were compelled to keep their windows and doors closed night and day.

SEWAGE DISPOSAL.

Minnesota is comparatively a young state. The question of sewage disposal seems to have been largely overlooked by cities, villages and corporations. The fact that sewage purification works make no financial returns upon the money invested fails to give them the popularity enjoyed by well-paying water works. It is a fact that the proper disposal of sewage has been quite generally neglected until the offenders have been compelled, by due process of law, or by threats of legal proceedings, to take action. Such compulsion has been quite limited in Minnesota up to the present time. One of the state institutions was enjoined against the pollution of a stream with its sewage, with the result that a precipitation tank and filter beds were put in. (See Mr. Wilson's report on the state hospital at Rochester, page 277.)

The First State Asylum at Anoka was the result of a compromise in the legislature of 1899 between the advocates for the establishment of a fourth hospital for the insane and the establishment of asylums. The institution was opened March 14, 1900, with a transfer of 100 male patients from the St. Peter State Hospital. The building had been constructed with little regard for sanitary requirements. The patients were of the chronic, or incurable, type, and were used as workers on the farm. The bathing facilities for these 100 workmen consisted of two bath rooms, with one bath tub in each room. The closets were neither of modern or sanitary construction. Provisions for the disposal of sewage were most antiquated. A cesspool was located but a short distance from the building, and it was necessary to pump and haul the sewage from this cesspool daily. This method of disposal soon became intolerable, and the State Board of Health was appealed to to correct the errors of those who had had the control of the construction of this building. Advice was given to the effect that filter beds might be constructed at a point designated between the building and the Rum river.

Early in 1901 the State Board of Health was again appealed to, this time by the Anoka Water Company, with the complaint that the sewage from the Anoka asylum was being discharged into the Rum river almost directly across the stream from the point at which the water supplying Anoka was derived. An inspection showed this to be the fact. Further advice was given to the asylum authorities as to the proper disposal of this sewage, and Mr. Geo. L. Wilson was requested to inspect the place. This he did. His report is given on page 272. The advice embodied in Mr. Wilson's report, a copy of which was given to the Board of Control, was not followed. Under date of Oct. 17, 1901, Mr. Lee, a member of the Board of Control, called at this office to discuss the disposal of sewage at this asylum. He suggested building a dyke along the river bank at the point where the sewage is now allowed to accumulate, and also cutting the sewer from the building off at a higher point than its present outlet and carrying the sewage along the side of the bank higher up than at present, in order that it might be discharged upon filter beds to be constructed. He was advised that the State Board of Health would only endorse such sewage disposal system if approved by a sanitary engineer. He suggested that the Board of Control go ahead with the plans he had outlined without the approval of the State Board of Health, and that said board should visit the place later to determine whether it could approve of the work done, without sanitary advice, by the Board of Control. He was advised further that if the Board of Control chose to assume such responsibility it would not be interfered with at present. It was stated to him that if filter beds were properly constructed, as previously advised, it would be quite possible to dispose of the sewage at the point under consideration; but that, after the experience already had with the authorities, it was doubtful whether the plan he was outlining would be satisfactory. He was further advised that the place would be visited from time to time by representatives of the State Board of Health and by a sanitary engineer to determine whether this system of sewage disposal was satisfactory, and that, if it failed to purify the sewage before it reached the river, the same would be condemned.

At the time of making this report the so-called filter beds at the Anoka Asylum are still a failure.

SANITARY INSPECTION OF STATE INSTITUTIONS.

At the regular meeting of this board April 16, 1901, provision was made for employment of an engineer to make a general inspection as to the sanitary conditions at state institutions. Mr. Geo. L. Wilson was secured, and his report, including an inspection at the Anoka Asylum for the Insane, under date of April 13, 1901, is as follows:

FIRST STATE ASYLUM AT ANOKA, APRIL 13, 1901.

I visited the Minnesota State Asylum at Anoka on April 13th, and submit the following report.

The asylum building is situated one and one-quarter miles north of the center of the town, on the west bank of the Rum river. It is about 400 feet from the river and about 28 feet above the same.

Between the asylum and the river the ground is occupied by a grove of small trees, which extends for some distance up and down the stream. Opposite the river side, or in front of the building, the land is rolling, but with no decided elevations. The soil is sandy and cultivated for farm crops. The state grounds include some 600 acres.

At this date the building contains 120 patients, besides attendants. The whole number living in it may be taken at 130. The water supply is taken from a well 160 feet deep, situated immediately in the rear of the building, pumped into an elevated tank, from which it flows into the building. About 51,000 gallons of water are used per diem, or 39 gallons per capita, as estimated by the superintendent.

The plumbing in the building appears to be in good condition and of modern design.

The drainage system empties through a vitrified pipe sewer, which formerly ran into a cesspool near the building. Owing to trouble in maintaining this, the pipe sewer was extended to a point 450 feet from the cesspool, 50 feet from the river, and the cesspool filled up. The sewage now runs into a small box about four and one-half feet square, in which the heavier portions of the sewage lodge. The liquid flows out into a ditch about 550 feet long, extending along the river bank.

The drainage pipes leaving the building are placed much deeper than usual, and the sewer pipe has been laid with a grade that brings the outlet rather low along the bank. As a result the ditch is in damp ground, and the soil is a rich loam, through which the water does not filter so readily as it would through more sandy soil.

At the date of my visit sewage was standing in the ditch for about 250 feet, and the soil was considerably water-logged along the sides.

A noticeable odor of fresh sewage was apparent along the ditch, and for a short distance from it, but not to a distance of 100 feet. In the warmer weather it will probably be strong enough to cause serious trouble unless remedied.

In order to dispose of the sewage without creating a nuisance, I would offer the following suggestions:

First—For immediate relief the ditch leading from the outlet box should be on higher ground than at present. To effect this it is recommended that some 250 feet from the outlet a new connection should be made and a pipe laid which will empty at a higher level than the present outlet. From this point a new ditch should be dug, extending along the higher ground in order to get the benefit of the increased area and drier ground for filtering. At the end of the new outlet pipe a closed box, considerably larger than the one at the present outlet, should be constructed to act as a septic tank on a small scale. The new ditch should be so arranged that the sewage may be run into different portions of it at different times, so as to use the ground intermittently. The present ditch can and should be kept as a part of the disposal area.

The ditch should be located along the contour of the bank and level should be taken by an engineer to determine the best location. The cost of the proposed plan may be estimated at $250.

Second—For permanent relief: As it is proposed to increase the capacity of the asylum, some plan for the future disposal of the sewage should be adopted which will permanently take care of it. There are two possible ways which may be considered. One would be to construct a pipe sewer from the asylum to some point on the Rum river below the Anoka dam. This, while more expensive to construct at first, would operate with less attention from the asylum officials than any other. On account of the proximity to the Minneapolis water works this would meet with serious opposition. The distance would be about one and one-half miles, and the cost about $5,000. The other plan would be to take care of the sewage on the cultivated land of the farm at some point on the sandy

ground northwest of the asylum buildings. About 1,500 feet away there is ground which could be adapted to this purpose, and in the writer's opinion this is the best plan for permanent disposal.

The present location of the sewage outlet is too near the asylum. It is ground that should be available for recreation purposes for the inmates, and it is so near the river that the residents of Anoka cannot but feel that their water supply is contaminated by it.

In connection with the disposal of the sewage, as proposed, arrangements should be made at once to drain the present sloughs just northwest of the asylum grounds. This should be done for the benefit of the farm land as well as the sanitary effect on the asylum. A vitrified pipe should be laid from the river to the nearest slough and the other ditched to connect.

In this way the sewage would be taken care of on properly prepared filtration beds in accordance with the most recent practice. Whichever method is decided upon, plans should be prepared in advance of the construction of the new building, so that the building designs may be carried out with the sewerage system in view.

FIRST STATE ASYLUM AT ANOKA, OCT. 11, 1902.

I visited the Anoka Asylum on Oct. 11, 1902, to investigate the sewage disposal system in that institution.

In a previous report, dated April 13, 1901, the conditions existing at that date were described. Since then the following changes have been made:

Near the outlet of the lower sewer, as described in the former report, a space about 200 feet by 50 feet has been excavated to a depth of from two to four feet, the material taken out used to make a bank along the edge of the river. The area excavated has been leveled off and divided into three parts by running cross banks of sand about two and one-half feet high. In two of these parts eight inches of sand had been placed on the bottom. The third part, it was stated, is to be divided into two by a cross bank, and the same amount of sand will be placed on the bottom.

The sewage is brought into these divisions by an open box carrier (12 inches by 6 inches), so arranged that the sewage may be emptied into either division at will.

The sewage in these divisions is in pools separated from the river by the bank above referred to, about 18 feet thick, and the level of the ground is three to three and a half feet above the water in river.

Above these pools another box carrier (6 inches by 14 inches) at a higher level carries a part of the sewage into a ditch which empties further from the buildings.

At the present time it was stated that there are 136 patients. An addition, newly built, will provide for as many more.

When the sewage is turned into the excavated areas above described the action would appear to be that of straining out the grosser particles as it percolates into the river.

SECOND STATE ASYLUM AT HASTINGS, MAY 4, 1901.

Upon the State Asylum for the Insane at Hastings I submit the following report:

The institution at present consists of one building, constructed on the cottage plan. Work is begun, however, on the foundations for additional buildings that are to be constructed during the current year.

The present building is about two miles from the Hastings railroad depot, the distance being covered by a circuitous wagon road. A new bridge over the Vermillion river and a new road will shorten this distance nearly one-half.

At present there are about 125 patients, and with attendants the whole population of the asylum is about 140.

The ground owned by the state includes 640 acres, much of which is fine farming land. The beautiful wooded gorge of the Vermillion river is included as a part of the grounds where there is a considerable water power. The building is situated on high ground, with splendid natural drainage. At present the sewage of the building is carried out through a six-inch vitrified pipe down the steep hillside to the bank of the river into which it falls some 20 feet and is carried to the Mississippi. This provides an easy method of disposal and will be effective for some time.

In the future it may be desirable to carry the sewage to lower ground towards the river bottoms and use it for irrigation, or partially purify it before it is emptied into the stream. This will enable the gorge to be improved as a park for which it is by nature intended, and will make a most attractive spot.

The water used at the asylum is taken from a well 152 feet in depth, situated immediately at the rear of the asylum building and raised by a deep well pump to an elevated wooden tank. The amount of water used was stated to be 4,800 gallons per diem, or 34 gallons per capita.

The plumbing of the building appears to be good and of modern design.

FIRST HOSPITAL FOR THE INSANE, ST. PETER, MAY 13, 1901.

Upon the State Hospital for the Insane at St. Peter, I submit the following report:

The hospital grounds are situated about one and one-half miles from town. The buildings on section 29, township 110, range 29, are surrounded by well-kept and shaded lawns, face easterly and towards the Minnesota river, distant about one-fourth mile. There are high, rolling bluffs in the rear, and the grounds slope to the river in front. Considerable of the state ground, which is claimed to comprise about 700 acres, is too hilly for cultivation, but affords diversified park-like surroundings.

The water supply for the hospital is obtained from two 6-inch artesian wells 350 feet deep, through sandrock and limestone formation into water-bearing sandstone.

Water from the wells flows into an open reservoir with stone masonry walls. There appears to be no cause for contamination from surface water, but the storing of underground water in uncovered shallow reservoirs, especially in direct sunlight, provides ideal conditions for the growth of algae and other low organisms. The reservoir should be covered at the earliest practicable time, so as to shut out sunlight and prevent leaves and other foreign substances getting into the water. From the reservoir the water is pumped to an underground masonry tank on the hill back of the hospital buildings some 250 feet above pumps, and which gives over 100 feet head at the buildings.

No record of the amount of water pumped is kept, but as this is a matter of interest and value in planning for future water supply for other state institutions, it would be well to provide proper counters for the pumps and have records kept.

The plumbing of the buildings appears to be in admirable condition as far as seen, and was designed and executed in a manner that reflects credit on those who had charge of it.

The different buildings are all provided with separate drains leading to one main outlet sewer, and the grounds around buildings have drainage facilities to carry off surface water.

The main sewer passes through the grounds to a connection with a sandrock tunnel some 500 feet in length. Through this the sewage passes in a 12-inch vitrified pipe to the bottom lands near the river. The pipe sewer is continued across these bottoms and empties into the Minnesota river, the outlet being below water at

ordinary stages. The whole drainage appears to have been properly planned and is doing the required work.

SECOND HOSPITAL FOR THE INSANE, ROCHESTER, JUNE 8, 1901.

Upon the State Hospital for the Insane at Rochester, I submit the following report:

The hospital buildings are situated one and one-fourth miles east from the center of the town, and on land which is comparatively level around and in front of the buildings, while in the rear a small stream, Silver creek, flows through the grounds alongside the Winona & St. Peter Railroad. This creek is not only a small stream, but the flow entirely stops in dry weather.

The area of the state land is about 500 acres, and as much more is leased and farmed.

The population is about 1,100 patients and 200 attendants.

The water supply is obtained from four 8-inch wells, sunk near the engine house. These furnish an ample supply of water of excellent appearance. The water is pumped by two Worthington Duplex pumps from wells directly to a reservoir holding some 250,000 gallons and situated on a bluff some one-half mile from the buildings, the elevation giving a pressure of 48 pounds at engine room. No record is kept of the amount of water used. This is unfortunate, as the information of water consumption is valuable both in connection with the needs of other institutions and with reference to the sewage disposal. The pumps should be provided with counters and an account kept regularly.

The main buildings of the hospital are all connected with a system of pipe sewers which conducts the sewage to precipitation tanks located about 700 feet from the buildings. These tanks are substantially built of masonry and covered with a frame building. There are four tanks, each 20 feet by 45 feet by 4 feet. The tanks are so constructed that the sewage can be turned into any one of them at will and any one emptied. At the present time the sewage is allowed to flow through one tank and into a second, from which it passes out. The first tank receives the larger portion of the sediment or sludge. The first tank is emptied once a week, and the second tank about once a month. No chemicals are used to assist the precipitation. From the precipitation tanks the sewage passes into a "Shone" ejector, from which it is forced, by compressed air, to an elevated wooden tank some 400 feet from the building. The operation of this need not be discussed here fur-

ther than to say that it is automatic, and the attendants report the mechanism to work satisfactorily.

Around the elevated wooden tank referred to is an area of some two acres, divided by low ridges into 16 beds, each 70 feet square.

Four of these beds are daily filled with sewage to a depth of 9 to 12 inches. Each bed is therefore filled once in four days. The sewage filters away and the beds have been used continuously in this manner for some ten years. It was stated by the attendant that the surface of beds had not been removed during this time. A small amount of vegetation was growing on the beds and the surfaces, where dry, appeared to be of a spongy nature.

Some sewage was being run onto a neighboring field of oats at time of visit, and it is stated that in winter, owing to freezing of beds, about half the sewage goes into the creek.

In the construction of the beds, no sub-drainage was used, a serious omission and something that should be remedied by putting in proper tile drains, well and carefully laid, and in trenches back filled with porous material around pipes.

The sludge from precipitation tanks is pumped into pits in earth, size about 12 feet by 30 feet by 4 feet. Eight of these pits are used in turn, and the sludge remains in them until the water has drained out. The residue is taken out and spread on the land, then plowed under.

On the occasion of the visit referred to a strong smell of sewage about the buildings was caused by the plowing of a field at some distance away upon which the sludge had been spread.

As a means of improving the sewage disposal, the following changes are suggested and recommended:

First—Remove sludge pits across creek and railroad to a considerable distance from building.

Second—Arrange a set of filtration beds on opposite side of creek and railroad, there to be properly underdrained.

Third—Put in suitable underdrains in existing filter beds.

Fourth—As only three of the four tanks in precipitation building are used, there is a fine opportunity to try the "Septic Tank" treatment of the sewage. One of the existing tanks should be tightly roofed over to exclude light and air, and used to obtain useful information which would be of value to other state institutions and small towns, as this is the most advanced process for treating sewage at the present time.

THIRD HOSPITAL FOR THE INSANE, FERGUS FALLS, MAY 30, 1901.

Upon the Hospital for the Insane at Fergus Falls, I submit the following report:

There are eight buildings forming the asylum proper, arranged in a sem-circular plan, with buildings for heating, kitchens, etc., in the center and rear.

The buildings are situated on section 26, township 133, range 43, about one mile north from the center of the town of Fergus Falls, in a plat of land owned by the state and comprising 937 acres. The state buildings stand on an elevation of about 90 feet above the main street and commanding a view over the city and river valley.

The hospital takes its water from the city mains, an 8-inch pipe being laid from the town to the buildings. The City Water Company, a private corporation, pumps the water from the Red river, water power being used. The pressure at the pumps is ordinarily kept at about 55 pounds, which gives 10 pounds or less at the hospital buildings. Here the water is re-pumped to the head of 40 pounds.

The water is metered and paid for by water measurement. The amount used is about 145,000 gallons daily, or with the total number of people (1,500), the consumption is 97 gallons per capita per diem.

An experiment with deep wells as a source of water supply did not work satisfactorily, and a 30-year contract was made with the company operating the water works.

Owing to the amount paid annually for water, it has been thought that as a matter of economy the state should install its own plant.

The price paid for water is about six and one-fourth cents per 1,000 gallons, and, while this is not a high price, the amount for a year is quite a sum. A careful examination and estimate would determine the relative economy. In any event it would be well that the state should erect a tank or standpipe in case of any emergency from fire or accident to the present works.

The quality of the water appears to be good, though as it is taken from an open stream and mill pond, there is considerable vegetable growth. The banks of the stream were examined for over a mile above the intake and found to be wooded, free from buildings or contamination.

The ice supply of the hospital, and town as well, is taken from the river lower down and below a small brewery, the refuse from which is thrown into the river. This is not a sanitary arrangement and might properly be investigated with a view to changing it.

The plumbing of the hospital buildings is good, fixtures well trapped, and the whole constructed in a scientific manner. A general examination indicates that the system is in good order and well cared for.

The buildings are all provided with sewers which connect outside at manholes, so that two pipes take all the sewage from the hospital and join on the edge of state property, where they connect with the city sewer, which passes through the town and empties into the river. The size of the sewers in the grounds is nine inches in diameter. The city sewer is a ten-inch pipe and extends of this size for several blocks. At the time of inspection this was about one-half full from the normal flow. Some deposits in pipes and manholes indicated that the sewers do not receive much attention on the city side and are not flushed except by rains.

The buildings all have roof water connections with the sewers, which are too small to take away the storm water, and, in consequence, the sewage backs up into the kitchen, bakery, boiler room and cold storage building during heavy rains. In order to remedy this, it is recommended that an outlet sewer for the storm water be connected with the present sewers. This can easily be done and the storm water lead away into low ground on the state property where it will do no harm. The cheapest and best location for this should be determined by a line of levels and measurements. The usual dry weather flow is sufficiently taken care of through the city sewers as at present.

STATE TRAINING SCHOOL, RED WING, MAY 4, 1901.

Upon the State Training School at Red Wing, I submit the following report:

The school buildings are situated about one and one-half miles from the center of the town, on section 28, township 113, range 14, and the grounds include some 430 acres lying along the Mississippi river. The buildings are about 80 feet above the river on ground that provides good, natural drainage, and from the buildings there are beautiful views over the river.

The water for the institution is taken from a surface well 15 feet in diameter, sunk in the sand on the side hill near the river. It is supposed that the water comes from the land side and not from the river, as the water stands higher in the well than in the river. The well is some six feet deeper than the low water level of the river. The water is pumped into a reservoir on the bluff back of the school buildings, about 275 feet above the river. The consumption for all purposes is stated by the superintendent to be 30,000 gallons per diem in winter and 50,000 gallons per diem in summer. As the present total population is about 450, this gives an average of about 70 gallons in winter and 110 in summer.

The plumbing of the different buildings appears to be in fair condition; some places need slight attention. Ventilation of closets is good, except in the basement closet of the "A" family, where it is poor and should be remedied.

The main building, the kitchen annex, cottage and laundry buildings are connected by 9-inch vitrified pipes, with an outlet sewer that runs down to the river and empties about 150 feet from the river in front of the main building across the railway tracks. The balance of the way the sewage runs to the river in an open trench. The school building has a separate pipe sewer and outlet near the one above mentioned.

The girls' building is about 800 or 900 feet from the main building and has a separate sewer running across the railway tracks and emptying some 50 feet from the river. As there is a large fall, these sewers have taken everything without trouble unless clogged by some foreign articles.

To continue to discharge the sewage as at present will be offensive in warm weather, and the pipes should be carried out to the river and made to discharge below low water. The river should be examined at low water to see if there is sufficient current at the point of discharge to carry everything away.

The two principal outlets are about 850 feet apart and now empty at a higher level than the well referred to and on both sides of it, though at some distance. While the conditions may not be dangerous, yet they should be changed and all sewage collected and carried out through a common outlet emptying under water. This is especially desirable, as it is proposed to improve the river front and make it a park feature of the school grounds. This can be easily done and make a very attractive spot.

I have to acknowledge the kindness of Mr. Brown, the superintendent, who gave me the figures used in this report for water consumption and assisted me in examining the buildings.

MINNESOTA STATE REFORMATORY, ST. CLOUD, MAY 18, 1901.

Upon the Minnesota State Reformatory at St. Cloud, I have to submit the following report:

The location is on slightly elevated and rolling ground two and one-half miles east from the center of the town. The buildings are situated on section 6, township 30, range 35. The state grounds include some 960 acres. Farming, gardening, granite quarrying and cutting are carried on by the inmates, besides other branches of labor. The inmates and officers vary from 175 to 200 at different times.

The water is obtained from a well 84 feet deep, eight feet across and cribbed with timber. It is sunk through clay, gravel and sand to the underlying granite ledge on which is the water-bearing stratum. The water stands about five feet deep. It is pumped by a Gould Triplex pump, set about 20 feet from bottom of well, into two 1,000-barrel tanks and one 100-barrel tank set in attic of main building. The lift is 160 feet. The consumption in winter is stated to be 1,000 gallons per diem, an amount of 160 to 180 gallons per capita. The summer consumption is considerably more, but the amount is not known.

It should be noted that the capacity of the well is about reached at this time and an extension of the supply should be made at once.

It is stated that the last legislature made an appropriation for a new system, and the work should be attended to this season.

The plumbing appliances through the kitchens, laundry and bath rooms of the buildings are sufficient, and in the cell houses the arrangement which gives each cell a water closet and wash basin is an admirable one.

The system of plumbing for the new cell house is especially complete and the ventilation of same is admirable; that of the old ones was not so well planned. The plumbing of the new cell house may well be taken for an example in plumbing for other similar buildings. It is of interest to note that all of the plumbing for the new cell house has been performed by the inmates.

The drains from the building connect with a pipe sewer which leads from the grounds directly to the Mississippi river, some 6,000

feet distant. This pipe sewer was constructed for the reformatory and has at this time one other connection,—a hospital part way to the river and which uses the same sewer. The sewer empties into the river some 1,700 feet below the water power dam. As this is below the town, and the water supply of the town is taken from the river at a point some distance up stream, there is no possible contamination between the town. Further, the outlet for the sewer is opposite land covered with small trees and brush and near no dwelling. The sewage of the reformatory, therefore, appears to be well taken care of.

STATE PUBLIC SCHOOL, OWATONNA, JUNE 29, 1901.

Upon the State Public School at Owatonna I have to submit the following report:

The school consists of eleven buildings situated on rolling ground, slightly elevated above the town proper, and is on the west side of the town. The arrangement of the buildings is such as to carry out the idea of separate families so far as practical. The whole number of residents is about 250.

The water supply is taken from one or the other of two wells 360 feet deep, six inches in diameter. The amount of water used is stated by an attendant to be 300 barrels (15,000 gallons) per diem, but this is rather an estimate than an accurate amount. The water is pumped by deep well pumps into an elevated tank, and from this flows by gravity through the buildings.

The grounds have a considerable fall towards the "Straight river," a small stream flowing through the town. The buildings of the school have a system of pipe sewers, which carries the sewage to this stream, where it empties at a distance of some 2,000 feet from the school. The sewage of the town is also emptied into the same stream a short distance below.

This stream is small and the dry weather flow must be light. There appears to have been, so far, no trouble from the sewage, but it will not be long until both town and the state school will have to at least partially purify the sewage before emptying it into the river, as it flows through a good grazing country where the sewage contamination is now very evident, and the farmers will soon demand that the stream be kept in such condition that stock may use it and the shores be reasonably clean.

MINNESOTA STATE SCHOOLS AT FARIBAULT, JUNE 29, 1901.

Upon the Minnesota State Schools at Faribault I have to submit the following report:

The three State Schools for Defectives, Deaf and Blind are situated on a plateau elevated about 80 feet above the town of Faribault and distant from one-half to one mile. They are finely located along the edge of the plateau, and, while forming one department of the state's work, are under separate management.

The location of the buildings on high ground, with fine views of town and country scenery, surrounded with shady lawns and grounds which are being gradually improved and beautified, gives the impression that the state has wisely placed the home of its unfortunate children in a park where the sanitary conditions may be of the best.

The population of each, including patients and attendants, may be placed in round numbers as follows: School for Defectives, 900; for Deaf, 260; for Blind, 90.

The water supply of all the schools is furnished by the city. The water is taken from two wells, 675 feet, and 1,050 feet deep. The pumping station is about two miles from the schools on the opposite side of the town, and the water is pumped to a covered reservoir at an elevation giving 105 pounds pressure at the pump, and 60 pounds at the state buildings. Payment is made at the rate of 10 cents per 1,000 gallons, meter measurement, for the amount used by the schools.

A needed improvement is now being made in the supply to the School for Defectives by putting in 6-inch mains in the place of 4-inch. The recent analysis by the chemist of your board will give you definite information as to the quality of the water.

Some experimental work has been done at the School for the Deaf by Supt. J. N. Tate, looking towards an independent supply. A well 825 feet in depth (8-inch for 154 feet and 6-inch for 671 feet) has been drilled and an air lift installed. At a test the yield of the well was 300 gallons per minute for several hours. As this well is not connected with the pipe system or pump, other than the air lift, it will be necessary to put in a tank and reservoir, besides connecting with pumps, before it can be put in actual use.

In regard to the amount of water used, it appears from figures furnished by the superintendent that in the School for the Deaf the average consumption is about 60 gallons per capita. During May of this year the average was about 90 gallons.

At the School for Defectives during the three months of March, April and May, the records of the superintendent show the daily consumption to have been 43,787 gallons. This was used by about 850 persons, giving 51.5 gallons per capita, a valuable fact to know in considering the use of water at other state institutions, though it should be noted that this was principally by children.

The present buildings are provided with sewer facilities by a main sewer connecting with the city system and carried along the bluff in the rear of the school buildings, extending from the most northerly to the southerly buildings. This main sewer is connected with each building, and, so far as the drainage is concerned, gives as sufficient and convenient accommodation as could be desired.

So far as the question of disposal is to be considered, the present method simply adds sewage to that already poured into the river by the city. As the state institutions use about one-fifth of the water pumped at the city water works, it may be assumed that this is the proportion contributed to the sewage emptied into the river.

The farm cottages at the School for Defectives are situated where the sewage cannot be brought into the system that takes care of the other buildings, and, as it is planned to erect other cottages in the immediate vicinity, some separate method of disposal will have to be adopted.

After looking over the situation with the superintendent, Dr. Rogers, it is the writer's opinion that a combined filtration and irrigation plan can be adopted which will be economical in first cost and will furnish an opportunity to obtain valuable practical experience for the benefit of other state institutions, and will be a beginning in the solution of the problem of sewerage disposal for the towns of the state.

The state owns and farms several hundred acres of land as a part of the equipment of the school. A tract of this land lies on a lower level than any of the buildings, and it appears to be excellently adapted to the construction of filter beds with septic tanks, and, if found in the future to be desirable, the location is such that the sewage from all the buildings of the School for Defectives can be diverted to this ground.

In closing, the writer wishes to express his thanks to Dr. A. C. Rogers, superintendent, for his assistance in obtaining the data upon which this report is founded.

MINNESOTA SOLDIERS' HOME, JULY 6, 1901.

Upon the Minnesota Soldiers' Home I submit the following report:

The home is situated in Hennepin county, at Minnehaha Falls, and occupies some 50 acres lying on the point of land between Minnehaha creek and the Mississippi river.

The water supply is obtained from a well 1,060 feet in depth, and is of good quality. It is pumped into an elevated tank on the grounds, from which it flows, by gravity, to the buildings. There are eight of these which are used as dwellings, all provided with excellent sewer facilities. Owing to the sandrock formation, which extends under all the grounds, the sewers are all laid in tunnels. There are two separate systems of these tunnels with sewer pipes in them and two different outlets, both into the Mississippi. One of these extends out to the water near the steamboat landing, and, as it was uncovered and with some of the pipes broken, it was rather conspicuous.

The other outlet pipe ends on the face of the sandrock bluff and the sewage falls some 10 feet before running into the river. This arrangement can and should be improved by lowering the sewer pipe in the tunnel and extending it out into the water. Major Compton, the superintendent, has been making some repairs and changes in the outlets so as to bring the same out under water in the river. These changes are now in progress and will cost about $600. When completed, the drainage will be a fine system. As the number of residents fluctuates widely at different seasons, no figures as to population are given, but the capacity of the home as a whole is about 300. For the above reasons, also, its figures of the water consumption are unavailable.

UNITED STATES PUBLIC HEALTH SERVICE.

The necessity for a federal public health service had been recognized for years, and various attempts had been made to secure such. Various bills had been presented in the United States Congress. In 1902 two bills were presented, the first in the Senate by Mr. Spooner, of Wisconsin, Jan. 7, 1902, which reads as follows:

RELATING TO QUARANTINE AND THE PUBLIC HEALTH.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled.

That there is hereby established a commission of public health, to be composed of a commissioner and of a representative from each state and territorial board of health, the surgeons-general of the army and of the navy, the supervising surgeon-general of the marine-hospital service, or such other medical officer from either service as may be designated by the chief thereof, with the approval of the President, to be known as the "National Commission of Public Health," which shall be a bureau in the treasury department, and the duties of which shall be to collect and disseminate information with regard to the prevalence of infectious diseases in this and other countries; to collect and publish vital statistics; to prepare rules and regulations for securing the best sanitary condition of vessels from foreign ports and for preventing the introduction of infectious diseases into the United States, and their spread from one state or territory or the District of Columbia into another state or territory or the District of Columbia; and, in general, to make investigations, publish information, and formulate rules with a view to the preservation of the public health; and they shall perform such other duties as may from time to time be prescribed by the secretary of the treasury, with the approval of the President.

Sec. 2. That the executive officer of said commission shall be the commissioner, who, subject to the supervision of the secretary of the treasury, shall be charged with the administration of the laws relative to quarantine and the public health, and with the rules and regulations relating thereto. Said commissioner shall be appointed by the President of the United States, by and with the advice and consent of the Senate, and his term of office shall be six years; he shall be a physician holding a diploma from a legally incorporated medical college in good standing; he shall have had at least ten years' experience in the practice of his profession, shall be learned in sanitary science, practically familiar with quarantinable diseases, and shall hold a membership in one or more reputable sanitary or medical societies or associations in the United States. He shall receive a salary of six thousand dollars per annum, and in addition the actual and necessary traveling expenses incurred in the performance of his official duties.

Sec. 3. That there shall be appointed by the secretary of the treasury, upon the recommendation of the commission, an assistant commissioner of public health, who shall possess similar qualifications prescribed by section two for the commissioner, who shall receive a salary of four thousand dollars per annum and all actual and necessary traveling expenses incurred in the performance of his official duties. That there shall be an executive committee, consisting of nine members of the commission, of which the commissioner, the representative from the army, the navy, and the marine-hospital service shall be ex officio members, the remaining five members of said committee to be elected by the commission at its annual meeting, the term of office of the members so elected to be one year. The executive committee may be convened by the commissioner whenever in his judgment the public interest shall so demand, and the said executive committee shall be convened by the commissioner when any three members thereof shall in writing so request. The said executive committee shall have, when the commission is not in session, full power to modify the regulations adopted by the commission, and to make new regulations; and the regulations, as modified or made by said executive committee, shall, when approved by the President of the United States, have the same force and effect as if the same had in the first instance been adopted by the commission.

Sec. 4. That the commission of public health shall annually, on the second Tuesday of January of each year, meet in the city of Washington, and at such other times as in the opinion of the secretary of the treasury the condition of the public health shall demand. It shall be the duty of the commissioner of public health to preside at all meetings of said commission, and in case of his absence a president pro tempore shall be chosen by the commission. The meetings of said commission shall not include more than six days at each session, unless a longer time shall be authorized by the President; and the actual and necessary traveling expenses of the members of said commission and of the said executive committee to and from all meetings, and their actual expenses while in attendance thereon, shall be paid on vouchers, in the form to be prescribed by the secretary of the treasury.

Sec. 5. That the commission of public health hereby created shall be provided with proper offices in the city of Washington, District of Columbia, in which it can conveniently transact its business, said offices to be supplied with proper fixtures, laboratories, and all needful apparatus and appliances, and all buildings, boats, laboratories, fixtures, and appliances now occupied and used by the marine-hospital service for quarantine or public-health purposes shall be transferred to the said commission of public health.

Sec. 6. That it shall be the duty of said commission of public health to perform all the duties in respect to quarantine and quarantine regulations which are provided for by this act, or by any existing act of the Congress of the United States, and all duties in regard to the prevention and spread of diseases throughout the United States, and to obtain information of the sanitary condition of foreign ports and places from which infectious diseases are or may be imported into the United States; and to this end the consular officers of the United States, at such ports and places as shall be designated by the commissioner of public health, shall make weekly reports to the secretary of state for transmission to the commission, through the secretary of the treasury, of the sanitary condition of the ports and places at which they are respectively stationed, according to such forms as the commission of

public health shall suggest, with the approval of the secretary of state; and the commissioner of public health shall also obtain, as far as may be, through all sources accessible, including state and territorial sanitary authorities throughout the United States, weekly reports of the sanitary condition of ports and places within the United States, and shall prepare, publish, and transmit to collectors of customs, and to state and territorial boards of health, and through them to municipal health officers and other sanitariums, weekly abstracts of the consular sanitary reports and other pertinent information received by him, and shall also, as far as he may be able, by means of voluntary co-operation of state and territorial health authorities, and, through them, municipal health authorities, public associations, and private persons, procure information relating to the climatic and other conditions affecting the public health.

Sec. 7. That a special report of the said commission of public health, relative to such action as will most effectually protect and promote the health of the people of the United States, may at any time be required by the President. That whenever any department of government, or the executive of any state or territory, or the commissioners for the District of Columbia, or the health authorities of any state, shall request information from the commission of public health in regard to any matter pertaining to the protection or promotion of the public health, said commission shall promptly furnish such information as it may possess, together with any necessary or pertinent advice; and whenever any information shall be received by the commission which the interests of the public health require should be promptly communicated to any department of the government or to any state officer, such information shall be forthwith furnished to the respective department or officer. That in communicating information to and receiving reports from the different states and territories the commissioner shall conduct all correspondence through the state or territorial health authorities, except that in his discretion, when in his judgment the public interest will be thereby subserved, he may in addition communicate information to and receive reports from the local health officers.

Sec. 8. That the commission shall take such action, by adopting and enforcing rules and by correspondence or conference, as will tend most effectually to secure the co-operation of state, municipal, and local boards of health in establishing and maintaining an efficient and accurate system of notification of the existence and progress of contagious or epidemic diseases in the United States; and said commission shall also, by co-operation with the health authorities of foreign nations and municipalities, endeavor to extend to the United States a reliable system of international notification of the existence and progress of such diseases as cholera, yellow fever, typhus fever, smallpox, bubonic plague, or any other dangerous infectious disease.

Sec. 9. That the secretary of the department of agriculture and the commissioner of the department of labor shall, respectively, furnish for the use of the commission of public health such information as they shall from time to time gather upon the following and kindred subjects, to wit:

First—The investigation of foods, drugs, liquors, and wines, their standard of purity, and their adulterations.

Second—The transmission of disease from animals to man, and vice versa, such as tuberculosis, glanders, and so forth.

Third—The statistics of climate with relation to infectious or other diseases.

Sec. 10. That any vessel at any foreign port, clearing for any port or place in the United States, shall be required to obtain from the consul, vice-consul, or other consular officer of the United States at the port of departure, or from the medical officer, where such officer has been detailed by the President of the United States for that purpose, a bill of health in duplicate, in the form prescribed by the commission of public health, setting forth the sanitary history and condition of said vessel, and that it has in all respects complied with the rules and regulations in such cases prescribed for securing the best sanitary condition of said vessel, its cargo, passengers, and crew; and said consular or medical officer is required, before granting such duplicate bill of health, to be satisfied that the matters and things therein stated are true; and for his service in that behalf he shall be entitled to demand and receive such fees as shall by lawful regulations be allowed, to be accounted for as is required in other cases. That it shall be unlawful for any merchant ship or other vessel, from any foreign port or place, to enter any port of the United States except in accordance with the provisions of this act and with such rules and regulations of state, territorial, or municipal health authorities as may be made in pursuance of or consistent with this act; and any such vessel which shall enter, or attempt to enter, a port of the United States in violation thereof shall, upon conviction thereof, in a proper proceeding at the instance of the United States government in an indemnity court of the United States, forfeit to the United States a sum not to exceed five thousand dollars, which shall be a lien upon said vessel, to be recovered by proper proceedings in the proper district court of the United States; and any master of any vessel who shall enter, or attempt to enter, any vessel into a port of the United States in violation of the provisions of this section, shall, upon conviction thereof, be deemed guilty of a misdemeanor, punishable by a fine not to exceed one thousand dollars, or by imprisonment for a term not exceeding six months, or both, in the discretion of the court. In such proceedings the United States district attorney for such district shall appear on behalf of the United States, and all such proceedings shall be conducted in accordance with the rules and laws governing cases of seizure of vessels for violation of the revenue laws of the United States. The President of the United States, in his discretion, is hereby authorized to detail any medical officer of the government to serve in the office of the consul at any foreign port for the purpose of furnishing information and making the inspection and giving the bills of health hereinbefore mentioned.

Sec. 11. That the commissioner of public health shall from time to time issue to the consular officer of the United States, and to the medical officers serving at any foreign port, and otherwise make publicly known the rules and regulations made by the commission of public health to be used and complied with by vessels in foreign ports for securing the best sanitary condition of such vessels, their cargoes, passengers, and crews, before their departure for any port in the United States, and in the course of the voyage, and all such other rules and regulations as shall be observed in the inspection of the same on the arrival thereof at any quarantine station at the port of destination, and for the disinfection and isolation of the same, and the

treatment of the cargo and persons on board, so as to prevent the introduction of cholera, yellow fever, leprosy, bubonic plague, smallpox, or other infectious disease; and it shall be unlawful for any vessel to enter said port or discharge its cargo or land its passengers or crew except upon a certificate of the health officer at such quarantine station, certifying that said rules and regulations have in all respects been observed and complied with, as well on his part as on the part of the said vessel and its master, in respect to the same and to its cargo, passengers, and crew; and the master of every such vessel shall produce and deliver to the collector of customs at such port of entry, together with the other papers of the vessel, the said bills of health required to be obtained at the port of departure and the certificate herein required to be obtained from the health officer at the port of entry; and that the bills of health herein prescribed shall be considered as part of the ship's papers, and when duly certified to by the proper consular officer, or other officer of the United States, over his official signature and seal, shall be accepted as evidence of the statements therein contained in any court of the United States.

Sec. 12. That the commissioner of public health shall, at such times as he may deem necessary, examine the quarantine regulations of all state and municipal boards of health, or detail an officer of said commission to make such examinations, and shall co-operate with and aid all state, municipal, and local boards of health in the execution and enforcement of the rules and regulations made by the commission of public health under the provisions of this act, or any other act of the Congress of the United States providing for a quarantine against disease, and to prevent the introduction of infectious diseases into the United States from foreign countries, and into one state or territory or the District of Columbia, from another state or territory or the District of Columbia; and all rules and regulations made shall operate uniformly so far as climatic or other unalterable conditions will permit, and in no manner discriminate against any port or place.

Sec. 13. That at such ports and places within the United States as have no quarantine regulations under state, territorial, or municipal health authority, and where such regulations, in the opinion of the commissioner of public health, are necessary to prevent the introduction of infectious diseases into the United States from foreign countries, or into one state or territory or the District of Columbia, from another state or territory or the District of Columbia, and at such ports and places within the United States as quarantine regulations exist under the health authority of state, territory, or municipality, which, in the opinion of the commissioner of public health, are not sufficient to prevent the introduction of such diseases into the United States, or into one state or territory or the District of Columbia from another state or territory or the District of Columbia, the commissioner of public health, if in his judgment it is necessary and proper, may, with the advice and approval of the executive committee, make such rules and regulations, additional or otherwise, as may be necessary to prevent the introduction of such diseases into the United States from foreign countries, or into one state or territory or the District of Columbia from another state or territory or the District of Columbia; and when said rules and regulations have been made and approved by the President of the United States they shall be promulgated by the commissioner of public health and enforced by

the health authorities of the state, territory, or municipality, where the state, territorial, or municipal health authorities will undertake to execute and enforce the same; but if the state, territorial, or municipal health authorities shall fail or refuse to enforce said rules and regulations the commissioner of public health is hereby empowered to execute and enforce the same, and to adopt such measures as in his judgment shall be necessary to prevent the introduction or spread of such diseases, and may detail or appoint officers for that purpose.

Sec. 14. That the commissioner of public health may make such rules and regulations, with the advice and consent of the executive committee and approval of the President of the United States, as are necessary to be observed by vessels at the port of departure and on the voyage, where such vessels sail from any foreign port or place to any port in the United States, to secure the best sanitary condition of such vessel, her cargo, passengers, and crew, which shall be published and communicated to and enforced by the consular officers of the United States. None of the penalties herein imposed shall attach to any vessel, or owner or officer thereof, until a copy of the rules and regulations made in pursuance of this act has been posted up in the office of the consul or other consular officer of the United States for ten days in the port from which said vessel sails; and the certificate of such consul or consular officer, over his official signature, shall be competent evidence of such posting in any court of the United States.

Sec. 15. That on the arrival of an infected vessel at any port not provided with proper facilities for treatment of the same the commissioner of public health will remand said vessel, at its own expense, to the nearest national or other quarantine station where accommodations and appliances are provided for the necessary disinfection and treatment of the vessel, passengers, cargo, and crew; and after treatment at such quarantine station, and after certificate shall been given by the quarantine officer in charge at such said station that the vessel, cargo, passengers, and crew, if allowed to remain on said vessel, are each and all free from infectious disease or danger of conveying the same, said vessel shall be admitted to entry to any port of the United States named in the certificate; but at any ports where sufficient quarantine provision has been made by state, territorial, or local health authorities the commissioner of public health shall direct vessels bound for said ports to undergo quarantine at such said state, territorial, or local quarantine station.

Sec. 16. That whenever necessary there shall be purchased or erected, under the orders of the commissioner of public health, with the approval of the secretary of the treasury, suitable warehouses where merchandise may be unladen and deposited from any vessel which shall be subject to a quarantine or other restraint, pursuant to the health laws of any state, or of the United States, at such convenient places therein as the safety of the public revenue and the observance of such health laws may require. That whenever the cargo of a vessel is unladen at some other place than the port of entry or delivery under the foregoing provisions all the articles of such cargo shall be deposited, at the risk of the parties concerned therein, in such public or other warehouses or inclosures as the collector of customs shall designate, there to remain under the joint custody of such collector and of the owner or master or other person having charge of such vessel, until the same are entirely unladen or discharged and until the articles so deposited may be

safely removed without contravening such health laws. And when such removal is allowed the collectors having charge of such articles may grant permits to the respective owners or consignees, their factors or agents, to receive all merchandise which has been entered and the duties accruing upon which have been paid, upon the payment by them of a reasonable rate of storage, which shall be fixed by the secretary of the treasury for all public warehouses and inclosures.

Sec. 17. That whenever it shall be shown to the satisfaction of the President of the United States that by reason of the existence of cholera, yellow fever, or other infectious or contagious diseases in a foreign country there is danger of the introduction of the same into the United States, and that, notwithstanding the quarantine defense, this danger is so increased by the introduction of persons or property from such country that a suspension of the right to introduce the same is demanded in the interest of the public health, the President shall have power to prohibit, in whole or in part, the introduction of persons and property from such countries or places as he shall designate and for such period of time as he may deem necessary.

Sec. 18. That whenever the proper authorities of a state shall surrender to the United States the use of the buildings, grounds, and disinfecting apparatus at a state or municipal quarantine station the secretary of the treasury shall be auhorized to purchase them at a reasonable compensation or pay a reasonable rental for their use if in his opinion they are necessary to the United States; and the expense of said purchase or rental is made payable from the epidemic fund.

Sec. 19. That the commissioner of public health is authorized, whenever a conformity to such quarantine and health laws requires it, and in respect to vessels subject thereto, to prolong the terms limited for the entry of the same and the report of the entry of their cargoes, and to vary or dispense with any other regulations applicable to such reports or entries. No part of the cargo of any vessel shall, however, in any case be taken out or unladen therefrom otherwise than is allowed by law or according to the regulations and rules adopted and promulgated by the commissioner of public health under the provisions of this act or any existing act.

Sec. 20. That whenever the evidence shall appear conclusive to the commissioner of public health that cholera, bubonic plague, smallpox, typhus fever, typhoid fever, diphtheria, scarlet fever, or other dangerous infectious disease exists in any state or territory, or in the District of Columbia, to such an extent that there is great danger of the spread of such disease into other states, territorics, or the District of Columbia by means of vessels and vehicles engaged in transportation of goods, passengers, and the United States mail by land or water, or by persons traveling, on foot or otherwise, and it shall appear conclusive that the state, territorial, or local health authorities are unable to prevent the spread of such disease, or that said health authorities are inefficient in the performance of their duties, he is hereby authorized, subject to the approval of the president, to take such action as may be necessary to prevent the spread of such disease from one state or territory into another, or from any state or territory into the District of Columbia, or from the District of Columbia into any state or territory; and the commissioner of public health shall make such rules and regulations, by and with the advice and consent of the executive committee and the

approval of the President, as may be necessary to meet the emergency, and all such rules and regulations shall have the force of law and supersede all other rules, laws, or regulations for the time being at the place designated; and anyone violating any such rules and regulations shall, upon conviction thereof, be subject to imprisonment for a period of not less than thirty days. The commissioner of public health may temporarily employ such inspectors and other persons as may be necessary to execute all rules and regulations adopted as aforesaid to stamp out and prevent the spread of such diseases.

Sec. 21. That it shall be lawful for the commissioner of public health, when in his judgment it may seem necessary, to confer upon any municipal or local health officer or health authority, through the state or territorial health authorities in which he may have jurisdiction, power also to enforce the provisions of this act and any rules and regulations made in pursuance thereof; and any person who shall knowingly disobey or violate any order, rule, or regulation made pursuant to the authority herein conferred, shall, upon conviction thereof, be deemed guilty of a misdemeanor, punishable by a fine of not less than five hundred dollars or by imprisonment for a period of not less than one year.

Sec. 22. That the commissioner of public health, assistant commissioner, medical officers of the United States, municipal and state health officers duly clothed with authority to act as quarantine officers at any port or place in the United States, or engaged in carrying out any of the provisions of this act, and when performing such duties, are hereby authorized to take declarations and administer oaths in matters pertaining to the administration of quarantine laws of the United States or the enforcement of any of the provisions of this act or any other acts of the Congress of the United States pertaining to quarantine or the prevention of the introduction and spread of contagious or infectious diseases within the United States.

Sec. 23. That the commissioner of public health shall make an annual report of the operations of the commission to the secretary of the treasury, with such recommendations as he may deem important to the public interest; and all mail matter of whatever class relative to the commission of public health and its duties, and addressed to the commissioner of public health and indorsed "official business, commission of public health," or mailed by said commission, shall be transported free of postage; and if any person shall make use of such indorsement to avoid the payment of postage in his private letter, package, or other matter in the mail, the person so offending shall, upon conviction thereof, be deemed guilty of a misdemeanor and be subject to the penalty prescribed by the existing law.

Sec. 24. That the commissioner of public health may engage the services of experts, not to exceed six in number, in such laboratories in the United States as are best adapted by location, equipment or special fitness to aid the commission of public health in making investigations, the pay to be allowed such experts to be fixed by the commissioner of public health, with the approval of the secretary of the treasury.

Sec. 25. That the secretary of the treasury may appoint for the bureau of public health one chief clerk, at a salary of one thousand eight hundred dollars per annum; one clerk of class three, at one thousand six hundred dollars; one clerk of class two, at one thousand four hundred dollars; four clerks, at one thousand dollars each; one messenger, at seven hundred and

twenty dollars; one stenographer, at one thousand two hundred dollars; one watchman, at six hundred dollars.

No officer nor person in the service of the United States detailed to perform any duty under the provisions of this act, or any existing acts of the Congress of the United States providing for quarantine against diseases, or to prevent diseases from spreading within the United States, shall receive any additional compensation except for actual and necessary traveling expenses incurred in the performance of such duties, such expenses to be approved by the commissioner of public health or his assistant, and to be paid on vouchers provided by the department of the treasury of the United States.

Sec. 26. That any officer or person acting as an officer, or an agent at any quarantine station or other place, or other person employed to aid in preventing the spread of disease, or any common carrier or officer, agent or employee of any common carrier, or any person who shall wilfully violate any quarantine laws of the United States, any of the provisions of this act, or any of the rules or regulations lawfully made and promulgated under the provisions of this act, or any other act of Congress providing for or regulating quarantine against disease or to prevent the spread of any disease within the United States, or any officer who shall disobey any lawful order of his superior officer in the execution of any of the provisions of this act, or any rule or regulation made and promulgated in accordance with any provision of this act, or any other act of the Congress of the United States providing for or regulating quarantine against disease or to prevent the spread of any disease within the United States, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than one hundred dollars nor more than five hundred dollars, or imprisonment for not more than one year, or both, in the discretion of the court.

Sec. 27. That all convictions for the violation of any of the provisions of this act, or any other act of the Congress of the United States providing for a quarantine against disease and to prevent the spread of any disease within the United States, shall be tried in the district where the offense was committed, and it shall be the duty of the United States district attorney for such district to appear on behalf of the United States; and all trials and proceedings shall be conducted in accordance with the rules and laws governing criminal cases triable in the United States courts.

Sec. 28. That all rules made and promulgated, adopted and published pursuant to the provisions of the act entitled "An act granting additional quarantine powers and imposing additional duties upon the marine-hospital service," approved February fifteenth, eighteen hundred and ninety-three, shall remain in force until the same are annulled, changed or modified as provided for by this act and other acts of Congress providing for quarantine against diseases and the spread of any disease within the United States.

Sec. 29. That all rules and regulations made and promulgated to enforce the provisions of this act, or any other act of the Congress of the United States providing for quarantine against disease and to prevent the spread of any disease within the United States, shall be approved by the President of the United States, and when so approved by him shall have all the force and effect of law.

Sec. 30. That there shall be, and hereby is, appropriated out of the moneys in the treasury and not otherwise appropriated, the sum of one hun-

dred thousand dollars for the purpose of this act. The sum of one million dollars already appropriated, and known as an emergency fund to be expended by the President of the United States, or the balance thereof not already expended, shall be a fund and held and expended at the discretion of the President of the United States in the execution of the provisions of this act.

Sec. 31. That the duties heretofore imposed by law upon and discharged by the marine-hospital service in relation to quarantine against diseases and the spread of any disease within the United States, shall continue to be discharged and performed by the said marine-hospital service until the fifteenth day of November, anno Domini nineteen hundred and two, at which time said duties shall devolve upon and be thereafter discharged by the commission by this act provided for, which shall take possession of the quarantine stations, and to which shall be transferred the services of all persons now employed under the marine-hospital service in quarantine duty and preventing the spread of disease within the United States.

Sec. 32. That all acts and parts of acts conflicting with or in any manner contravening the provisions of this act are hereby repealed; and this act shall take effect and be in force from and after its passage.

This bill provided for a commissioner, to be appointed by the President, with a term of office of six years, and a commission consisting of a representative from each state and territorial board of health, together with the surgeons general of the army and navy and the supervising surgeon general of the marine-hospital service. From this commission an executive committee was to have been appointed, consisting of five members.

This bill, while containing many good features, had the disadvantage of lack of permanency in its executive head.

The second bill presented was known as the Perkins-Hepburn bill, presented in the House of Representatives May 19, 1902. It reads as follows:

TO INCREASE THE EFFICIENCY AND CHANGE THE NAME OF THE UNITED STATES MARINE-HOSPITAL SERVICE.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled.

That the United States marine-hospital service shall hereafter be known and designated as the Public Health and Marine-Hospital Service of the United States, and the supervising surgeon-general and the officers now or hereafter commissioned under the act of January fourth, eighteen hundred and eighty-nine, entitled "An act to regulate appointments in the marine-hospital service of the United States," and acts amendatory thereof, shall hereafter be known as the surgeon-general, surgeons, passed assistant surgeons, and assistant surgeons of the public health and marine-hospital service of the United States. Nothing in this act contained shall be held or con-

strued to discharge any of the officers above named, or any of the acting assistant surgeons, pharmacists, and other employees of the marine-hospital service, or to deprive any officer of his commission or the benefits derived by longevity of service. The care of sick and disabled seamen and all other duties now required by law to be performed by the marine-hospital service shall hereafter be performed by the public health and marine-hospital service, and all funds and appropriations now provided by law for use by the marine-hospital service and all properties and rights pertaining to said service shall be available for use for like purposes and in like manner, under the treasury department, by the public health and marine-hospital service.

Sec. 2. That the salary of the surgeon-general of the public health and marine-hospital service shall be five thousand dollars per annum, and the salaries and allowances of the commissioned medical officers of said service shall be the same as now provided by regulations of the marine-hospital service.

Sec. 3. That commissioned medical officers, when detailed by the surgeon-general for duty in the public health and marine-hospital bureau at Washington, District of Columbia, in charge of the administrative divisions thereof, namely, marine hospitals and relief, domestic quarantine, foreign and insular quarantine, personnel and accounts, sanitary reports and statistics, and scientific research, shall, while thus serving, be assistant surgeons-general of the public health and marine-hospital service, but their pay and allowances shall be the same as now provided by regulations of the marine-hospital service for officers in charge of said divisions; and the senior officer thus serving shall be the assistant within the meaning of section one hundred and seventy-eight, revised statutes of the United States; *provided, however*, that no such officer shall be detailed in charge of said divisions who is below the rank of passed assistant surgeon.

Sec. 4. That the President is authorized, in his discretion, to utilize the public health and marine-hospital service in times of threatened or actual war to such extent and in such manner as shall in his judgment promote the public interest without, however, in any wise impairing the efficiency of the service for the purposes for which the same was created and is maintained.

Sec. 5. That there shall be an advisory board for the hygienic laboratory provided by the act of Congress approved March third, nineteen hundred and one, for consultation with the surgeon-general of the public health and marine-hospital service relative to the investigations to be inaugurated, and the methods of conducting the same, in said laboratory. Said board shall consist of three competent experts, to be detailed from the army, the navy, and the bureau of animal industry by the surgeon-general of the army, the surgeon-general of the navy, and the secretary of agriculture, respectively, which experts, with the director of the said laboratory, shall be ex officio members of the board, and serve without additional compensation. Five other members of said board shall be appointed by the surgeon-general of the public health and marine-hospital service, with the approval of the secretary of the treasury, who shall be skilled in laboratory work in its relation to the public health, and not in the regular employment of the government. The said five members shall each receive compensation of ten dollars per diem while serving in conference, as aforesaid, together with allowance for actual and necessary traveling expenses and hotel expenses while in con-

ference. Said conference is not to exceed ten days in any one fiscal year. The term of service of the five members of said board, not in the regular employment of the government, first appointed shall be so arranged that one of said members shall retire each year, the subsequent appointments to be for a period of five years. Appointments to fill vacancies occurring in a manner other than as above provided shall be made for the unexpired term of the member whose place has become vacant.

Sec. 6. That there shall be appointed by the surgeon-general, with the approval of the secretary of the treasury, whenever, in the opinion of the surgeon-general, commissioned medical officers of the public health and marine-hospital service are not available for this duty by detail, competent persons to take charge of the divisions, respectively, of chemistry, zoölogy, and pharmacology of the hygienic laboratory, who shall each receive such pay as shall be fixed by the surgeon-general, with the approval of the secretary of the treasury. The director of the said laboratory shall be an officer detailed from the corps of commissioned medical officers of the public health and marine-hospital service, as now provided by regulations for said detail from the marine-hospital service, and while thus serving shall have the pay and emoluments of a surgeon; *provided*, that all commissioned officers of the public health and marine-hospital service not below the grade of passed assistant surgeon shall be eligible to assignment to duty in charge of the said divisions of the hygienic laboratory, and while serving in such capacity shall be entitled to the pay and emoluments of their rank.

Sec. 7. That when, in the opinion of the surgeon-general of the public health and marine-hospital service of the United States, the interests of the public health would be promoted by a conference of said service with state or territorial boards of health, quarantine authorities, or state health officers, the District of Columbia included, he may invite as many of said health and quarantine authorities as he deems necessary or proper to send delegates, not more than one from each state or territory and District of Columbia, to said conference; *provided*, that an annual conference of the health authorities of all the states and territories and the District of Columbia shall be called, each of said states, territories and the District of Columbia to be entitled to one delegate; *and provided further*, that it shall be the duty of the said surgeon-general to call a conference upon the application of not less than five state or territorial boards of health, quarantine authorities, or state health officers, each of said states and territories joining in such request to be represented by one delegate.

Sec. 8. That to secure uniformity in the registration of mortality, morbidity and vital statistics it shall be the duty of the surgeon-general of the public health and marine-hospital service, after the annual conference required by section seven to be called, to prepare and distribute suitable and necessary forms for the collection and compilation of such statistics, and said statistics, when transmitted to the public health and marine-hospital bureau on said forms, shall be compiled and published by the public health and marine-hospital service as a part of the health reports published by said service.

Sec. 9. That the President shall from time to time prescribe rules for the conduct of the public health and marine-hospital service. He shall also prescribe regulations respecting its internal administration and discipline, and the uniforms of its officers and employees. It shall be the duty of the

surgeon-general to transmit annually to the secretary of the treasury, for transmission by said secretary to Congress, a full and complete report of the transactions of said service, including a detailed statement of receipts and disbursements.

Passed the Senate May 16, 1902.

Attest: CHARLES G. BENNETT,
Secretary.

The advantage of this bill was its simplicity, as it provided for a public health service by enlarging the work of an already existing and thoroughly equipped service. It had the advantage also of placing the service on a permanent basis.

In response to an informal call for a conference of representatives of state boards of health and quarantine stations, made by Dr. Edmund Souchon, president of the Louisiana State Board of Health, a meeting was held in Washington, March 12, 1902.

At this conference, thirteen states were represented by seventeen physicians, there being three delegates from South Carolina, two from Alabama, two from Delaware, and two from New York. The other states represented were Vermont, Massachusetts, Pennsylvania, Maryland, Louisiana, Missouri, Wisconsin, Minnesota. Surgeon-General Walter Wyman of the Marine Hospital Service, and Dr. H. L. E. Johnson, chairman of the legislative committee of the American Medical Association, were also present by request.

This conference had been called to consider the Spooner and Perkins-Hepburn bills. The general sentiment of those present seemed to be in favor of the Perkins-Hepburn bill, but certain changes in this bill were insisted upon, chiefly that the point covering the provision for the conference between the state and national boards of health. The feeling was general that an aggregation of states should have the right to request a conference with the national authorities. A committee of five was appointed from those present to present an amendment bearing on the above point. This committee consisted of Drs. A. H. Doty, New York City, H. M. Bracken, Minnesota, E. Souchon, Louisiana, H. L. Durgin, Boston, and M. Simons, South Carolina.

The original Section 7 of the Perkins-Hepburn bill read as follows:

Sec. 7. That when, in the opinion of the secretary of the treasury, the interests of the public health would be promoted by a conference with the state or territorial boards of health, or health authorities, the District of Columbia included, the surgeon-general of the United States health service is hereby authorized, with the approval of the secretary, to invite one or

more of said boards of health or authorities to send delegates, not more than one from each state or territory and District of Columbia, to said conference, and when thus convened, said delegates shall be entitled to reimbursement for their necessary expenses of travel and of maintenance not exceeding five days at the place of conference, in accordance with such regulations as may be made by the secretary of the treasury.

The committee of five recommended the following amendment of this section:

Sec. 7. That when, in the opinion of the surgeon-general of the United States health service, the interests of the public health would be promoted by a conference with the state or territorial boards of health or health authorities, the District of Columbia included, or on the application of five state boards of health or quarantine officers, the surgeon-general of the United States health service is authorized to invite representatives of state boards of health and quarantine officers to send delegates, not more than one from each state or territory and District of Columbia, to said conference, and when thus convened, said delegates shall be entitled to reimbursement for their necessary expenses of travel and of maintenance not exceeding five days at the place of conference, in accordance with such regulations as may be made by the secretary of the treasury.

This suggested amendment met with the approval of the Conference so far as was represented by the vote. Some of the strong advocates of the Spooner bill were not entirely satisfied, but they felt that some legislation would be better than no legislation at all and apparently acquiesced. Dr. E. Souchon had arranged that this conference should have a hearing before the committee on interstate and foreign commerce in the House on Thursday, March 13th, at 10:30, and before the public health and national quarantine committee of the Senate on Saturday, March 15th. After reaching the conclusion that Section 7 (referred to above) should be amended, it was not deemed advisable that the entire conference should appear before these committees of the House and Senate. Thereupon a committee of three, consisting of Dr. H. M. Bracken, Minnesota (chairman), Dr. Wm. H. Welch, Maryland, and Dr. Edmund Souchon, Louisiana, was appointed to go before these committees of the Senate and House to report the wish of the conference. Drs. Walter Wyman and H. L. E. Johnson, of Washington, were requested by the conference to accompany this committee in the hearing before the Senate and House committees. The hearing before the House committee was given Thursday morning, as previously arranged for. The report of the conference was favor-

ably received by this House committee. The fact was duly reported to the conference.

It was not thought necessary for the conference to continue in session until Saturday, nor for the committee to wait until that day in order to make its report to the Senate committee. An attempt was therefore made to see Senator Vest, chairman of the committee, but as he was in poor health, no appointment could be secured. A communication was sent therefore, advising him as to the action of the conference, and the matter of reporting in person was left to Dr. Walter Wyman. The conference committee also waited upon Senator Spooner and reported the action of the conference as favorable to the Perkins-Hepburn bill. Senator Spooner was not quite satisfied with the amendment of Section 7 of the Perkins-Hepburn bill suggested by the conference. He suggested an amendment to read as follows:

Sec. 7. That when, in the opinion of the surgeon-general of the United States health service, the interests of the public health would be promoted by a conference with the state or territorial boards of health or health authorities, the District of Columbia included, he may, or on application of five state boards of health or quarantine officers, the surgeon-general of the United States health service shall, invite representatives of state board of health and quarantine officers to send delegates, not more than one from each state or territory and District of Columbia, to said conference.

Section 7, as shown in its original form, together with the proposed amendments, should be compared with Section 7 of the bill as it was finally passed. (See page 298.)

The action of this conference was discussed April 10, 1902, by the legislative committee of the American Medical Association, called by Dr. H. L. E. Johnson, chairman. Said committee consisted of delegates, as follows: Dr. Geo. M. Sternberg, surgeon-general U. S. Army; Dr. John Van R. Hoff, U. S. Army; Dr. R. A. Marmion, U. S. Navy; Dr. Walter Wyman, Marine Hospital Service; Dr. D. E. Salmon, Chief Bureau of Animal Industry; Dr. H. L. E. Johnson, Washington, D. C.; Dr. Wm. H. Welch, Baltimore, Md.; Dr. Wm. R. Rodman, Philadelphia, Pa.; Dr. Chas. S. Rodman, Connecticut; Dr. Geo. Cook, New Hampshire; Dr. J. C. Egan, Louisiana; Dr. G. E. Reading, New Jersey; Dr. C. E. Black, Illinois; Dr. R. M. Cunningham, Alabama; Dr. P. Marvel, New Jersey; Dr. John B. Roberts, Pennsylvania; Dr. C. R. Shinault, Arkansas; Dr. U. O. B. Wingate, Wisconsin; Dr. Emil Amberg, Michigan; Dr. A. J. Bruist, South Carolina; Dr. Harris, New York; Dr. H. M. Bracken, Minnesota; Dr. G. Elliott, Connecticut; Dr. W. P. Goff, W. Virginia.

This committee, by vote, endorsed the Perkins-Hepburn bill with the amendment as proposed by Senator Spooner. The chairman, Dr. Johnson, appointed a committee of three, consisting of Drs. H. M. Bracken, Minnesota, W. P. Goff, West Virginia, and Emil Amberg, Michigan, to present this action to the proper committees of Congress assembled. To this committee, by vote of the legislative committee, was added Dr. H. L. E. Johnson.

SUNDRY REPORTS.

CONGRESS OF TUBERCULOSIS.

A call had been sent out by Clarke Bell, Esq., secretary of the Medico-Legal Society, for a congress to be held in New York, June 2, 1902. This congress had not been a success in past years (two meetings), and a special effort was to be made this year with Dr. H. D. Holton, of Vermont, as president, to make of this a satisfactory session. Again, however, it was a failure. Very few representative medical men were in attendance. The papers presented and the discussions of same were, with but few exceptions, very unsatisfactory. The question as to the future of the congress was discussed more or less in private by those in attendance. The points under discussion were first, as to whether a further attempt should be made to put this congress on a proper footing, or second, whether the present congress should be abandoned and a new organization set on foot. It was decided to make one more attempt to place the present congress on a desirable footing, and with this end in view Dr. Daniel Lewis, of New York, was chosen as the new president.

CONFERENCE OF RAILWAY SURGEONS.

This conference was called May 3, 1902, to discuss the desirability of general vaccination of all railway employes in the state of Minnesota. The following were present:

Dr. Walter Courtney, representing the Northern Pacific Railway.
Dr. J. A. Quinn, representing the Great Northern Railway.
Dr. W. E. Rochford, representing the C., M. & St. P. Railway.
Dr. H. Sneve, representing the C. G. W. Railway.
Dr. J. F. Pritchard, representing the Wisconsin Central Railway.
Dr. Wm. H. Magie, representing the D., Missabe & N. Railway.
Dr. J. D. Budd, representing the Duluth & Iron Range Railway.
Dr. P. M. Hall, representing the Minneapolis Health Dept.
Dr. G. A. Renz, representing the St. Paul Health Dept.
Dr. H. M. Bracken, representing the Minnesota State Board of Health.

After the subject had received very thorough discussion, the following resolutions were presented and approved unanimously:

Resolved, That the consensus of opinion at this meeting is that vaccination of employees should be adopted by all railroads because we believe that railroad employees disseminate smallpox at times, and because vaccination prevents smallpox;

Resolved, That the railroad officials be requested to use their influence so far as possible to have all regular employees, whether in shops, general offices or in other departments, vaccinated;

Resolved, That it is the sense of this conference, in order to limit and prevent the spread of smallpox, that all applicants for service should be required to present evidence of successful vaccination within five years preceding, or satisfactory evidence of immunity from smallpox;

Resolved, That on roads where the last preceding resolution is not practical, the following is recommended for adoption;

That general managers shall require all men in train service, including conductors, brakemen, engineers, firemen, as also depot employees and coach cleaners, to be vaccinated, or show certificate of having been vaccinated within the preceding five years, and that no new employees be accepted in their service without such certificate or other evidence of immunity.

CHARTS

SHOWING MONTHLY MORTALITY.

The average for eleven years, 1887-1897 inclusive, is shown in black.

The average for two years, 1898-1899, is shown by a red line.

The average for two years, 1900-1901, is shown by a green line.

CHART NO. I.—DIPHTHERIA.
CHART NO. II.—CROUP.
CHART NO. V.—SCARLATINA.
CHART NO. VI.—MEASLES.
CHART NO. IX.—TUBERCULAR DISEASES.
CHART NO. X.—PNEUMONIA.
CHART NO. XIII.—BRONCHITIS.
CHART NO. XIV.—TYPHOID FEVER.
CHART NO. XVII.—DIARRHŒAL DISEASES OF CHILDREN.

These charts disregard the increase in population from year to year. They have a bearing, therefore, on the actual deaths, and not on the death rate.

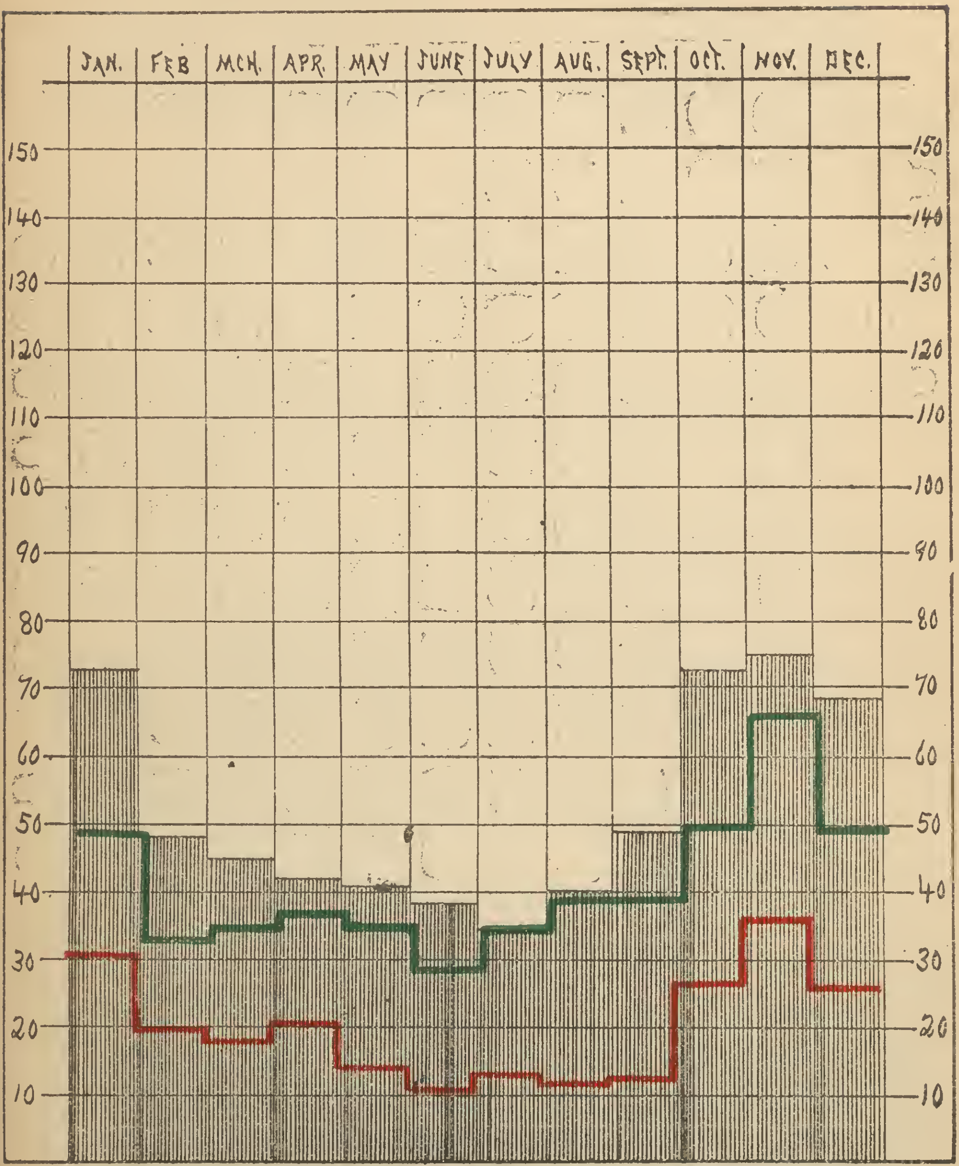
CHARTS

SHOWING AVERAGE ANNUAL DEATH RATES PER 100,000 POPULATION IN CLASSES OF POPULATION FOR TWELVE YEARS, 1888-1899, IN COMPARISON WITH TWO YEARS, 1900-1901.

NOTE.—The population for each year is estimated by adding the average annual increase as shown by the United States census of 1880, 1890 and 1900 to each succeeding year.

CHART NO. I.—DIPHTHERIA.

MONTHLY MORTALITY FOR FIFTEEN YEARS—1887-1901 INCLUSIVE.



The black section shows the average monthly deaths for eleven years, 1887-1897 inclusive.

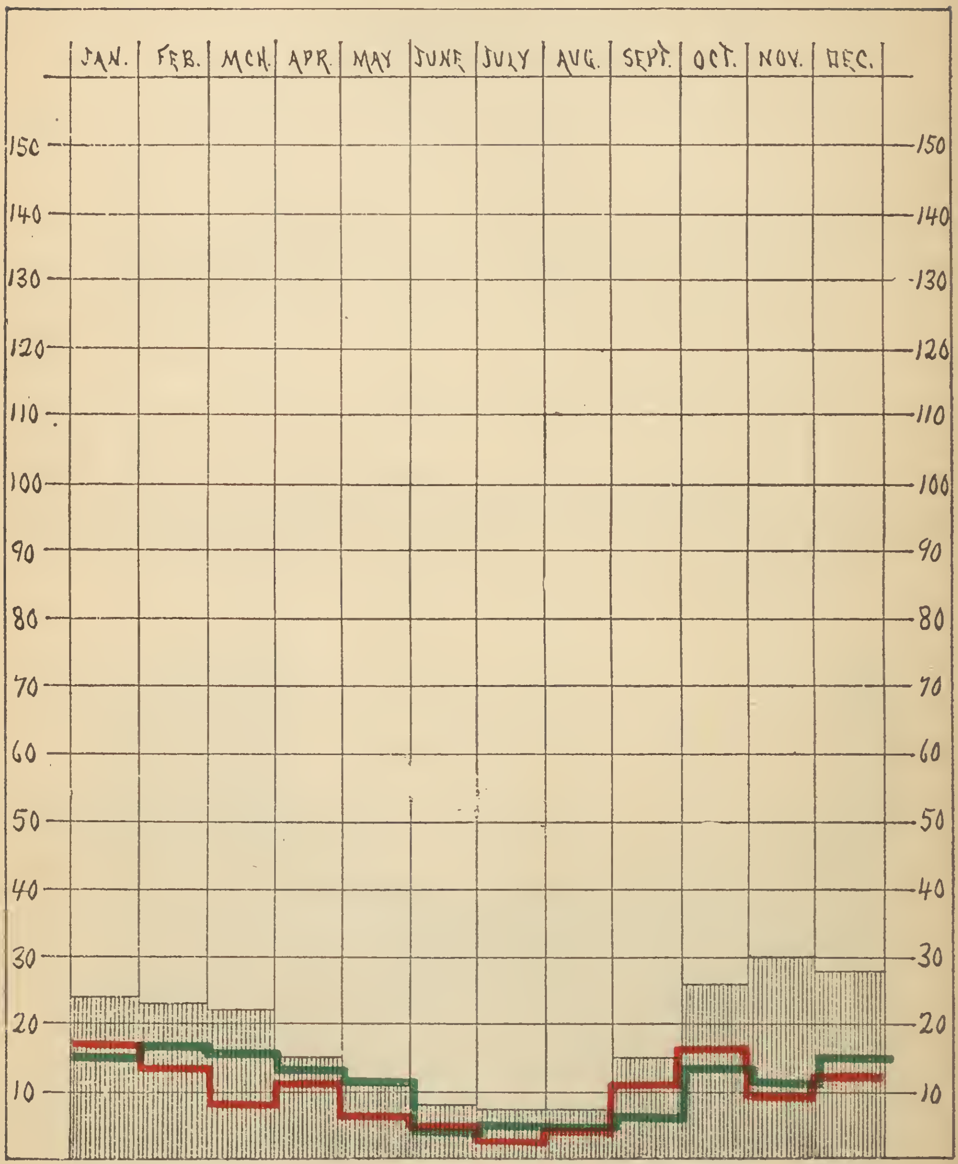
The red line shows the average monthly deaths for two years, 1898-1899.

The green line shows the average monthly deaths for two years, 1900-1901.

It is discouraging to note that the death rate from diphtheria for the last two years has been almost as high as that for the eleven years preceding 1898. It means a great increase in the number of cases, for the death rate as shown under the heading diphtheria (page ......) is low. Such an increase in the nvmber of cases must be due to carelessness in methods, and duration, of quarantine

CHART NO. II.—CROUP.

MONTHLY MORTALITY FOR FIFTEEN YEARS—1887-1901 INCLUSIVE.



The black section shows the average monthly deaths for eleven years, 1887-1897 inclusive.

The red line shows the average monthly deaths for two years, 1898-1899.

The green line shows the average monthly deaths for two years, 1900-1901.

There is little to learn from this chart further than the fact that some physicians still call some of their fatal diphtheria cases croup.

CHART NO. III.—DIPHTHERIA

Deaths per 100,000 Population.

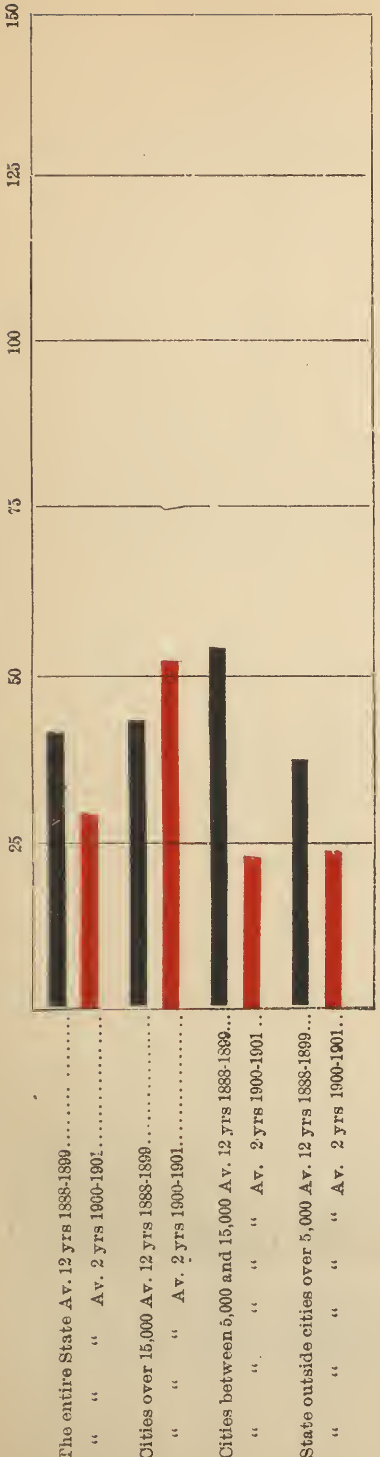


CHART NO. IV.—CROUP.

Deaths per 100,000 Population.

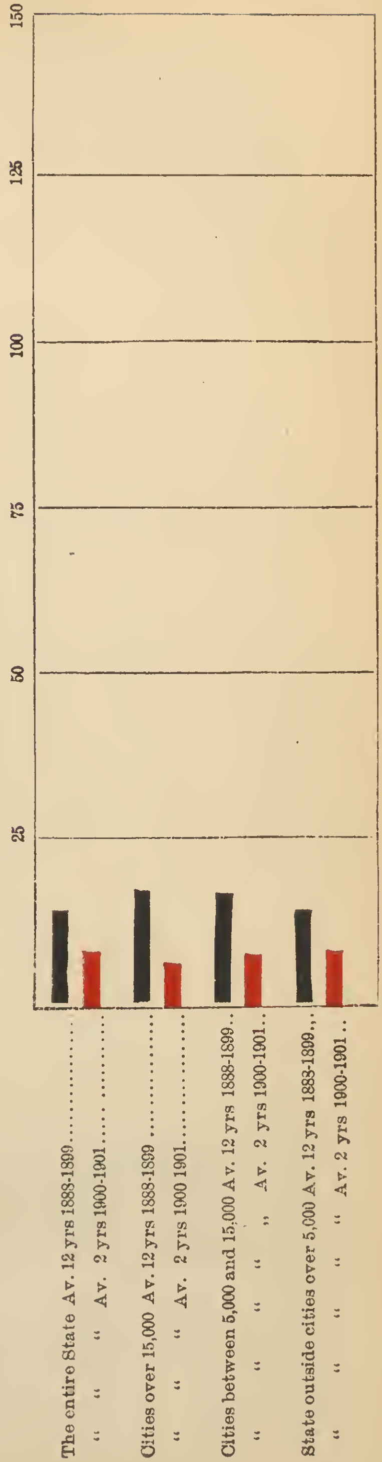
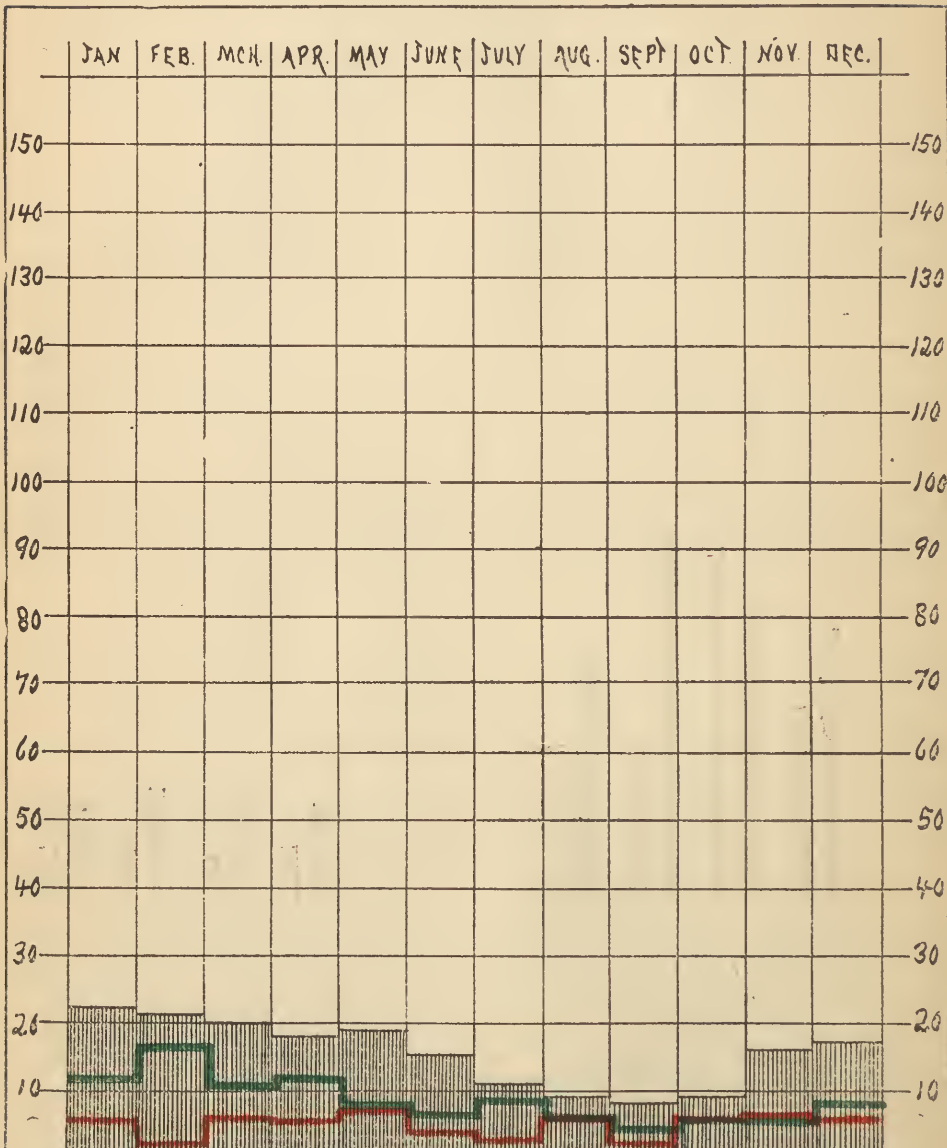


CHART NO. V.—SCARLET FEVER.

AVERAGE MONTHLY MORTALITY FOR FIFTEEN YEARS—1887-1901 INCLUSIVE.



The black section shows the average monthly deaths for eleven years, 1887-1897 inclusive.

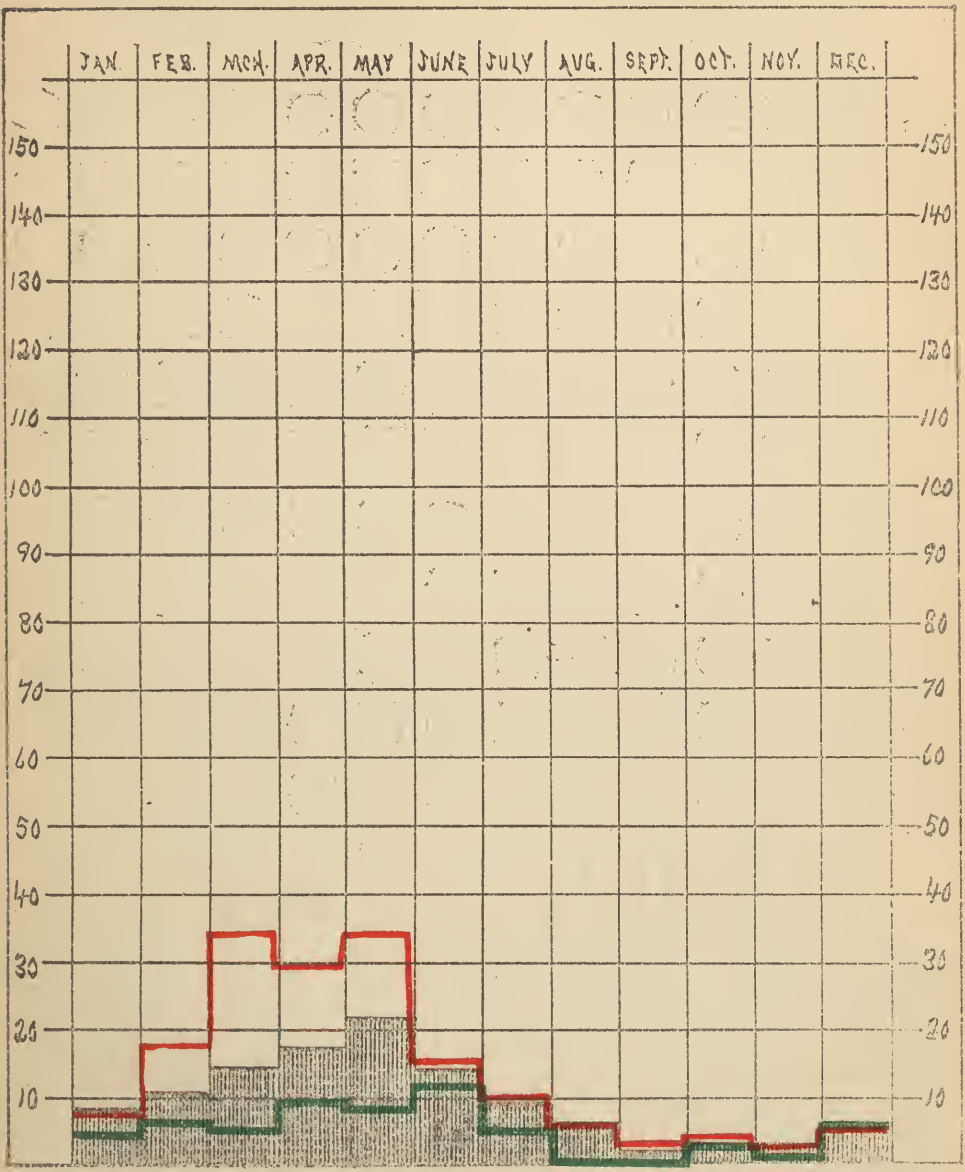
The red line shows the average monthly deaths for two years, 1898-1899.

The green line shows the average monthly deaths for two years, 1900-1901.

The mortality from scarlet fever has been remarkably low in Minnesota since 1894.

CHART NO. VI.—MEASLES.

AVERAGE MONTHLY MORTALITY FOR FIFTEEN YEARS—1887-1901 INCLUSIVE.



The black section shows the average monthly deaths for eleven years, 1887-1897 inclusive.

The red line shows the average monthly deaths for two years, 1898-1899.

The green line shows the average monthly deaths for two years, 1900-1901.

During the years 1898-1899 measles showed an increased mortality, but during the last two years recorded the death rate was again low.

CHART NO. VII.—SCARLET FEVER.

Deaths per 100,000 Population.

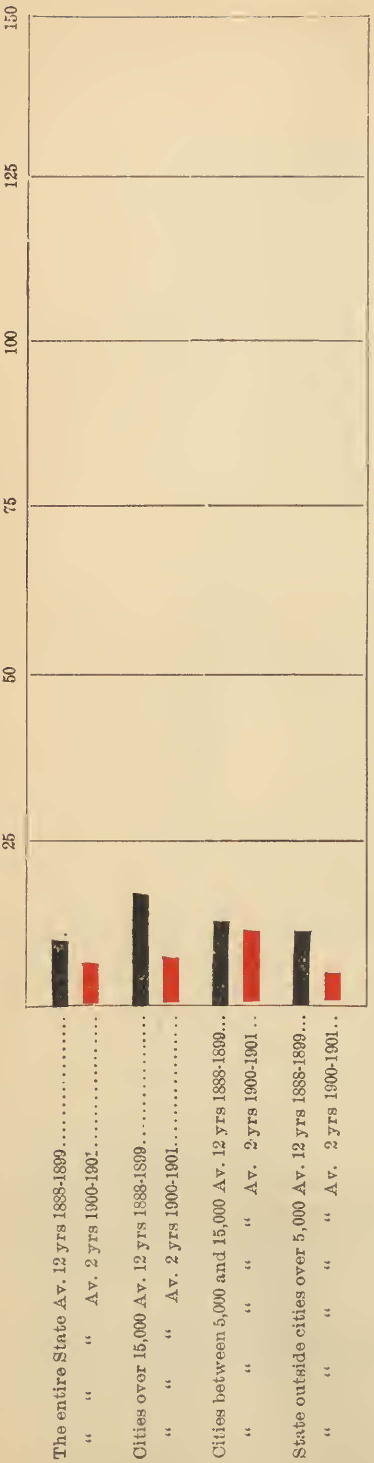


CHART NO. VIII.—MEASLES.

Deaths per 100,000 Population.

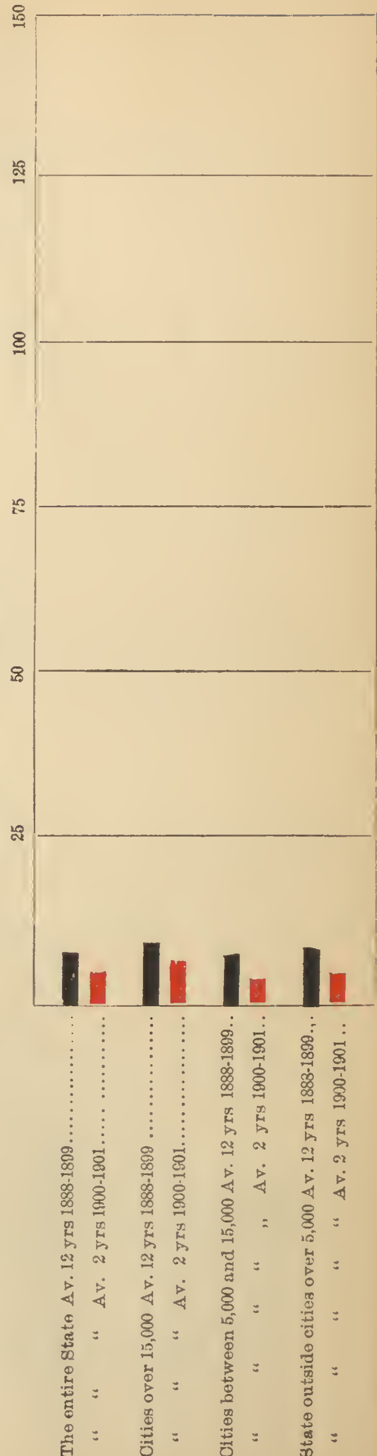
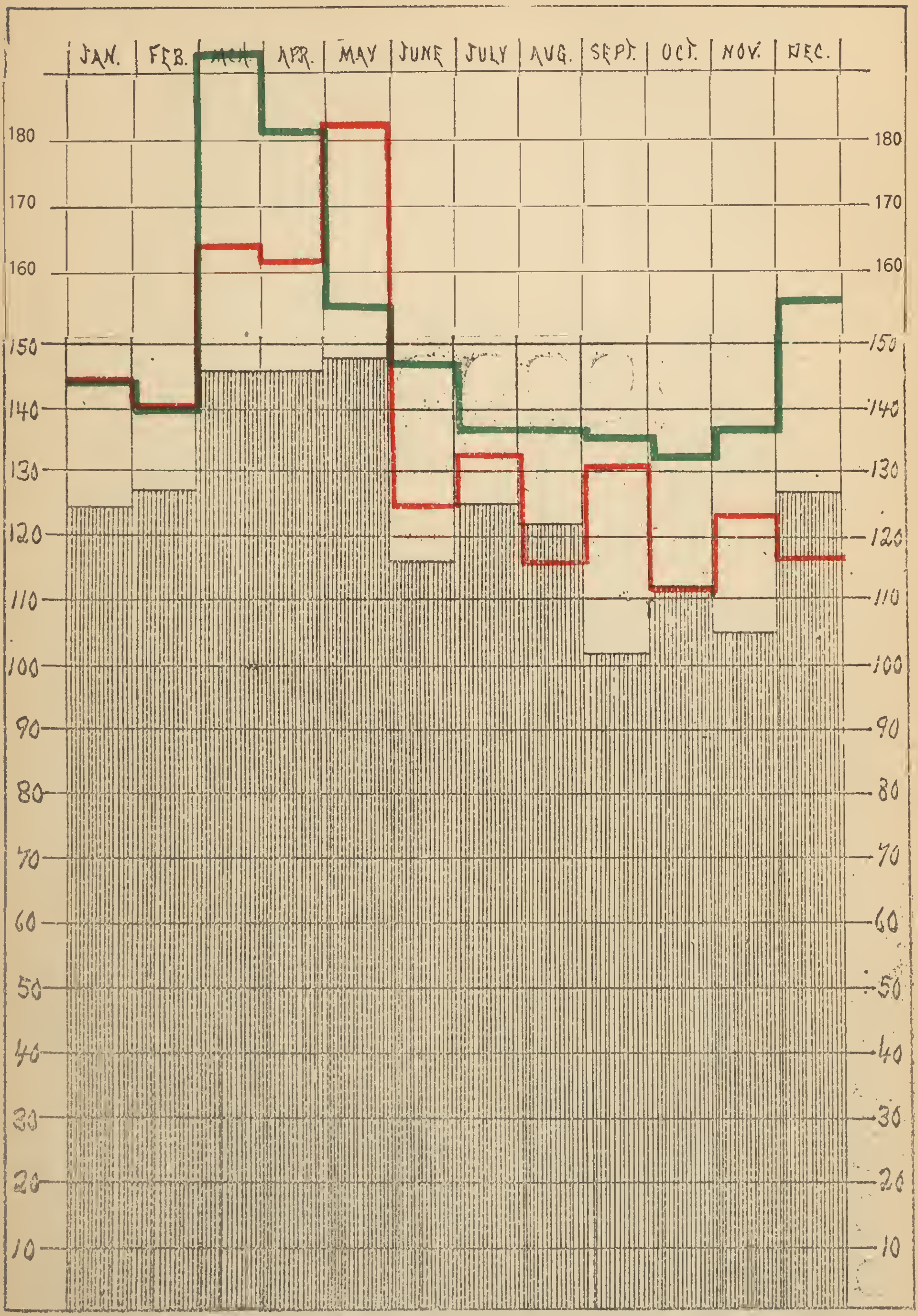


CHART NO. IX.—TUBERCULAR DISEASES.

AVERAGE MONTHLY MORTALITY FOR FIFTEEN YEARS—1887-1901 INCLUSIVE.



The black section shows the average monthly deaths for eleven years, 1887-1897 inclusive.

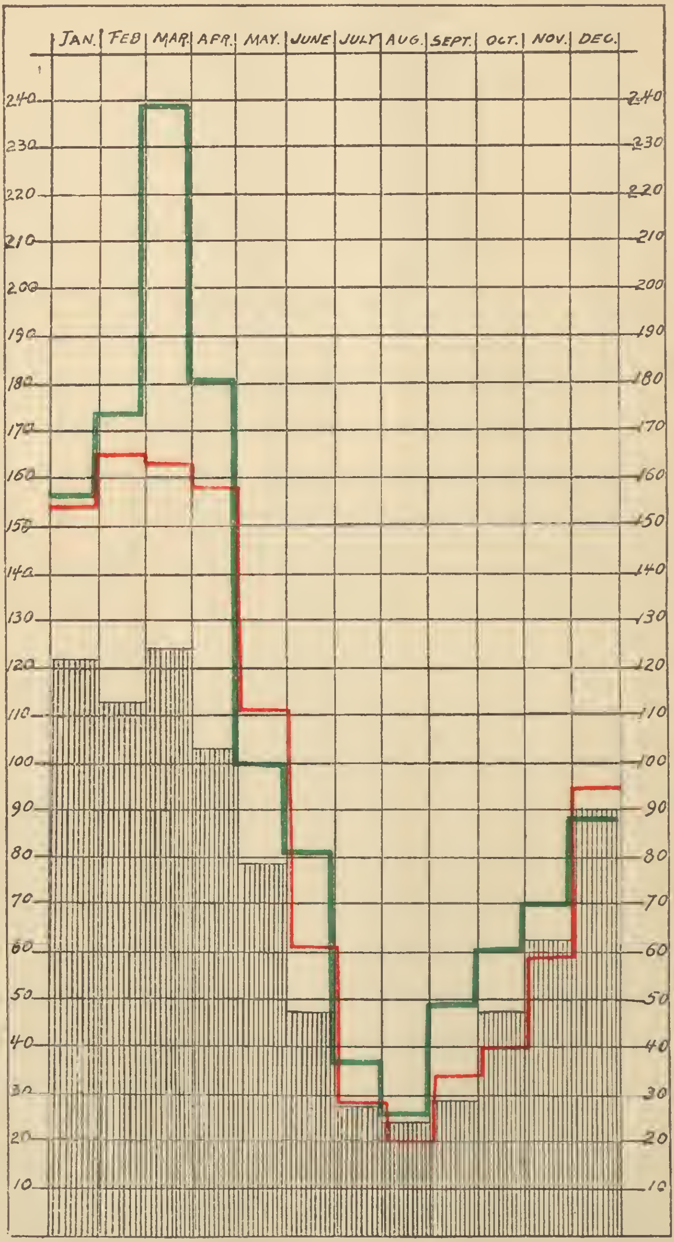
The red line shows the average monthly deaths for two years, 1898-1899.

The green line shows the average monthly deaths for two years, 1900-1901.

It is quite evident that tuberculosis should receive more attention as a communicable disease.

CHART NO. X.—PNEUMONIA.

AVERAGE MONTHLY MORTALITY FOR FIFTEEN YEARS—1887-1901 INCLUSIVE.



The black section shows the average monthly deaths for eleven years, 1887-1897 inclusive.

The red line shows the average monthly deaths for two years, 1898-1899.

The green line shows the average monthly deaths for two years, 1900-1901.

It would seem from this chart that pneumonia was increasing in frequency in Minnesota. The chart's evidence is supported by clinical evidence.

CHART NO. XI.—TUBERCULAR DISEASES.

Deaths per 100,000 Population.

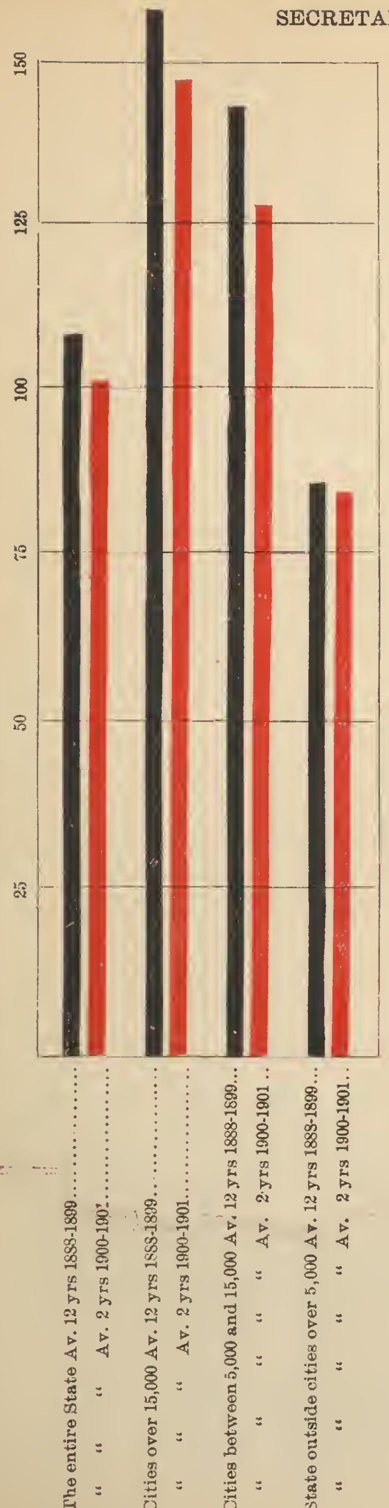


CHART NO. XII.—PNEUMONIA.

Deaths per 100,000 Population.

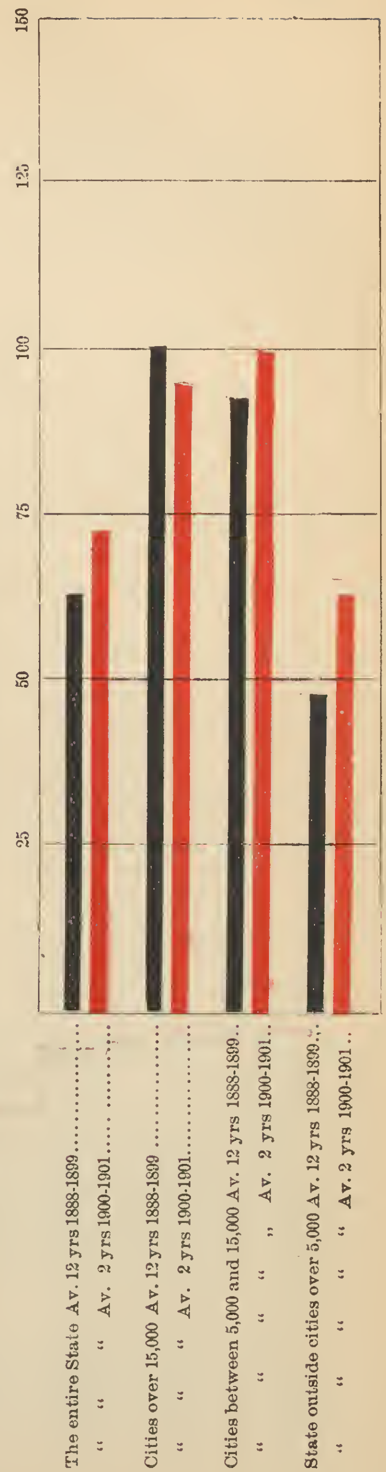
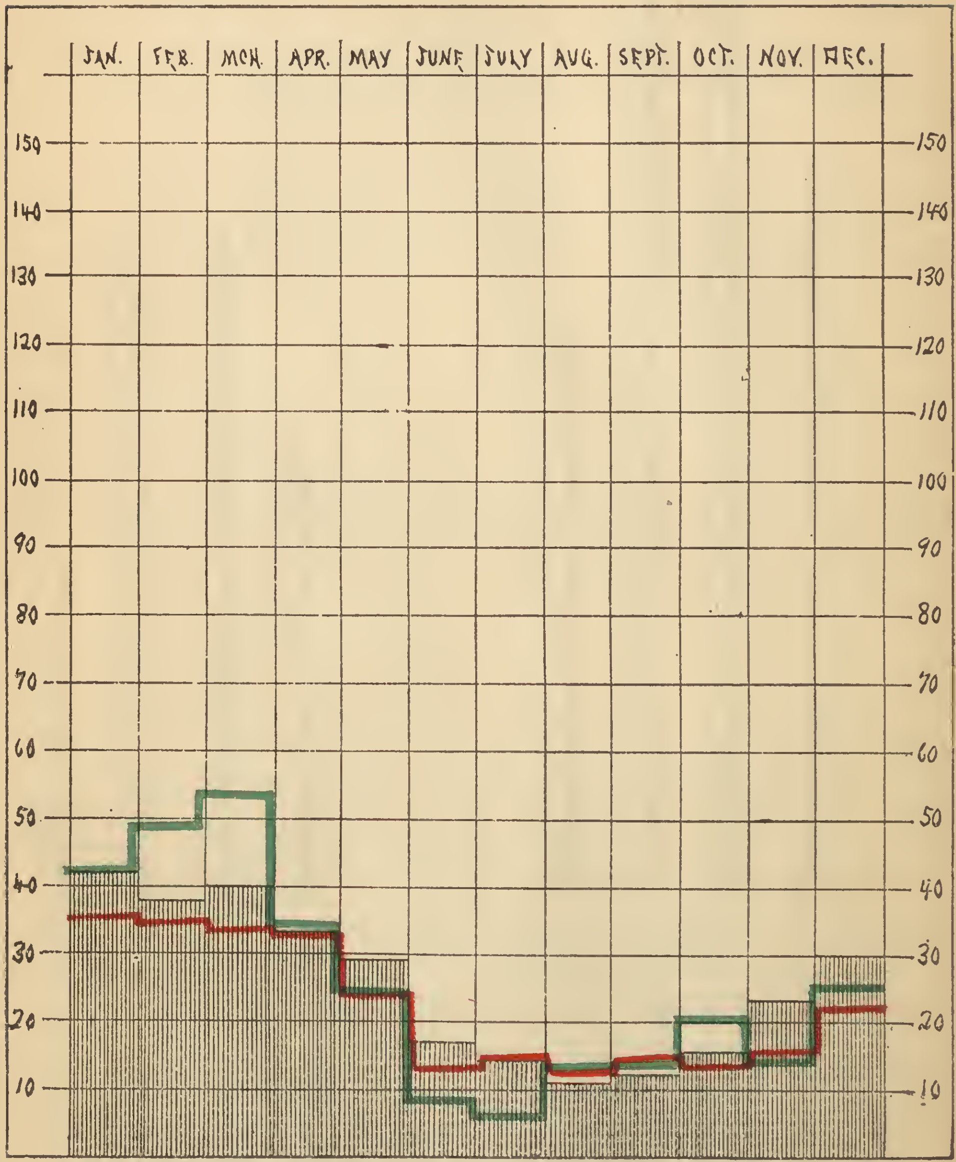


CHART NO. XIII.—BRONCHITIS.

AVERAGE MONTHLY MORTALITY FOR FIFTEEN YEARS—1887-1901 INCLUSIVE.



The black section shows the average monthly deaths for eleven years, 1887-1897 inclusive.

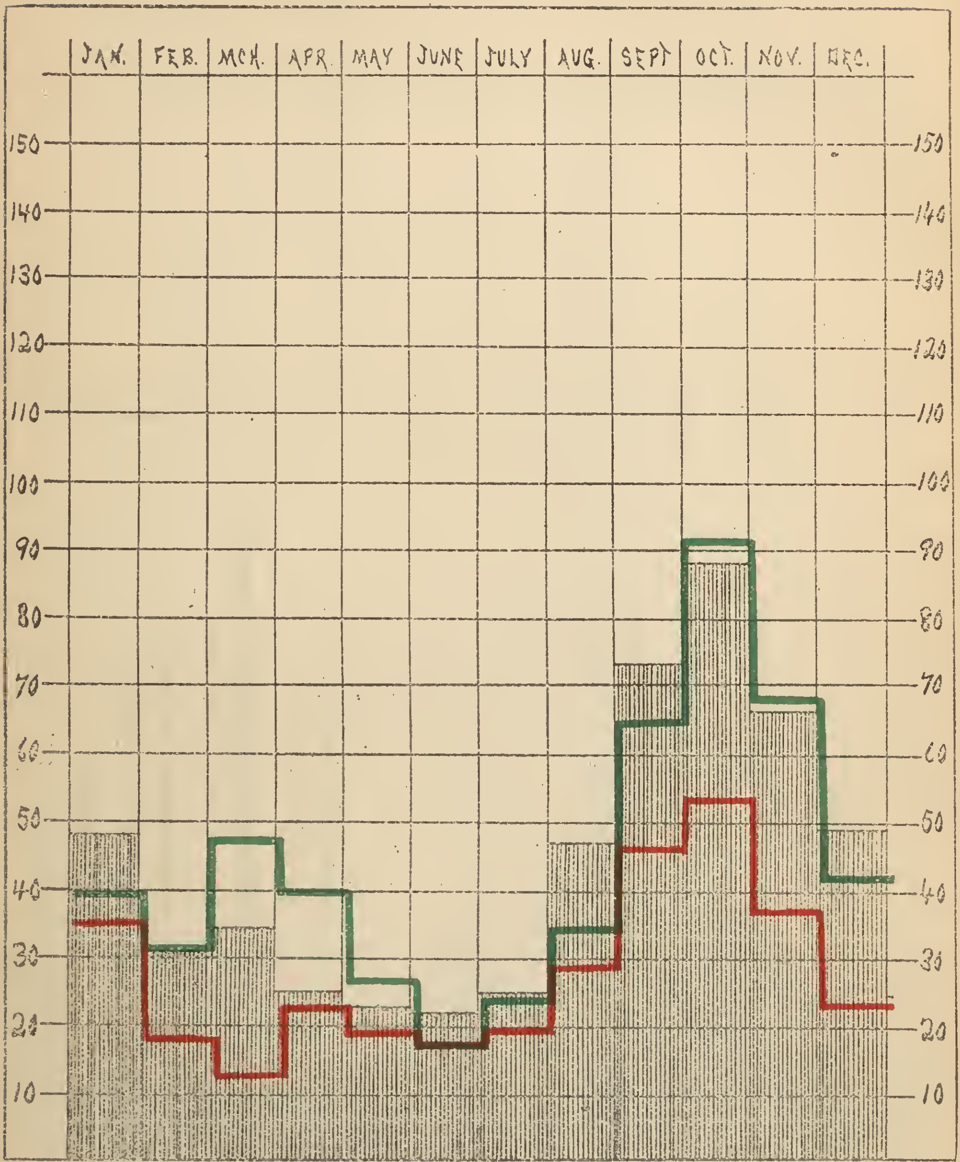
The red line shows the average monthly deaths for two years, 1898-1899.

The green line shows the average monthly deaths for two years, 1900-1901.

It would seem that the deaths from bronchitis were becoming more general in Minnesota. This may be accounted for in part by the increase in number of old people in the state; in part by the apparent increase in other diseases of the respiratory tract, pneumonia.

CHART NO. XIV.—TYPHOID FEVER.

AVERAGE MONTHLY MORTALITY FOR FIFTEEN YEARS—1887-1901 INCLUSIVE.



The black section shows the average monthly deaths for eleven years, 1887-1897 inclusive.
The red line shows the average monthly deaths for two years, 1898-1899.
The green line shows the average monthly deaths for two years, 1900-1901.

CHART NO. XV.—BRONCHITIS.

Deaths per 100,000 Population.

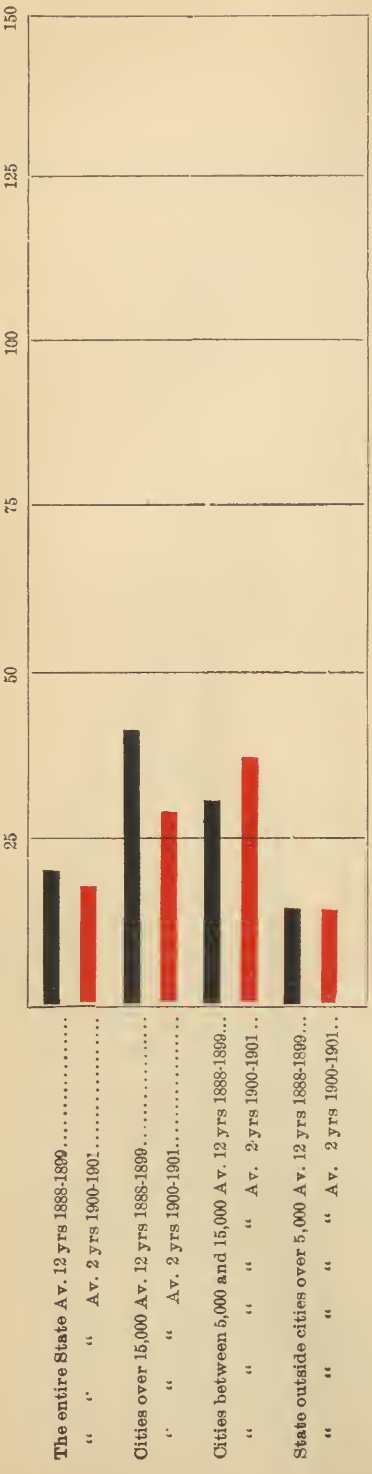


CHART NO. XVI.—TYPHOID FEVER.

Deaths per 100,000 Population.

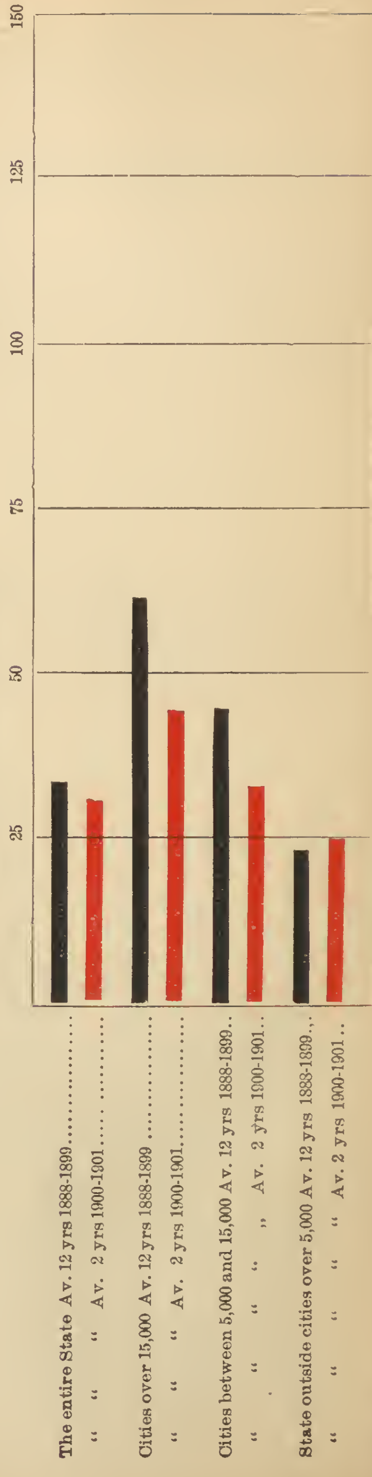
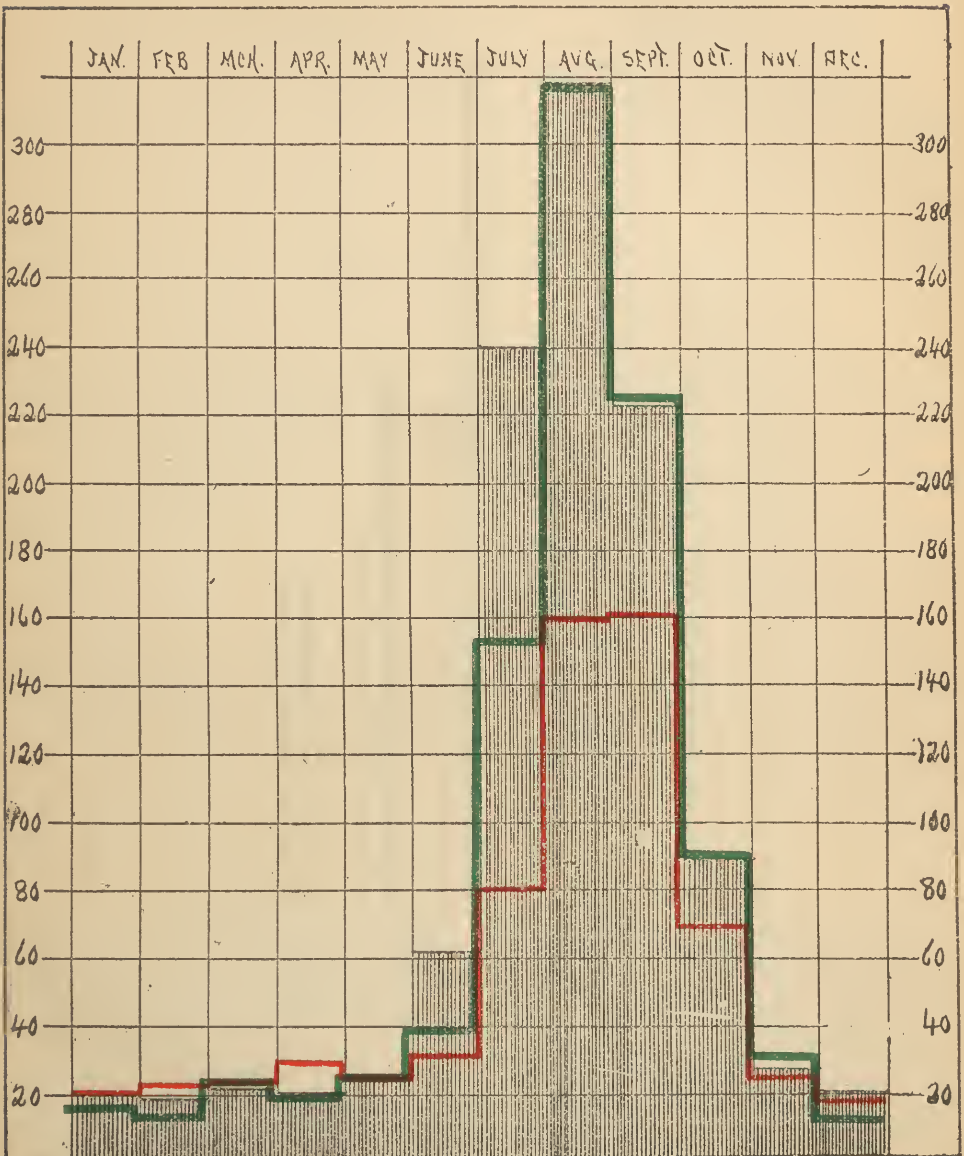


CHART NO. XVII.—DIARRHŒAL DISEASES OF CHILDREN.

AVERAGE MONTHLY MORTALITY FOR FIFTEEN YEARS—1887-1901 INCLUSIVE.



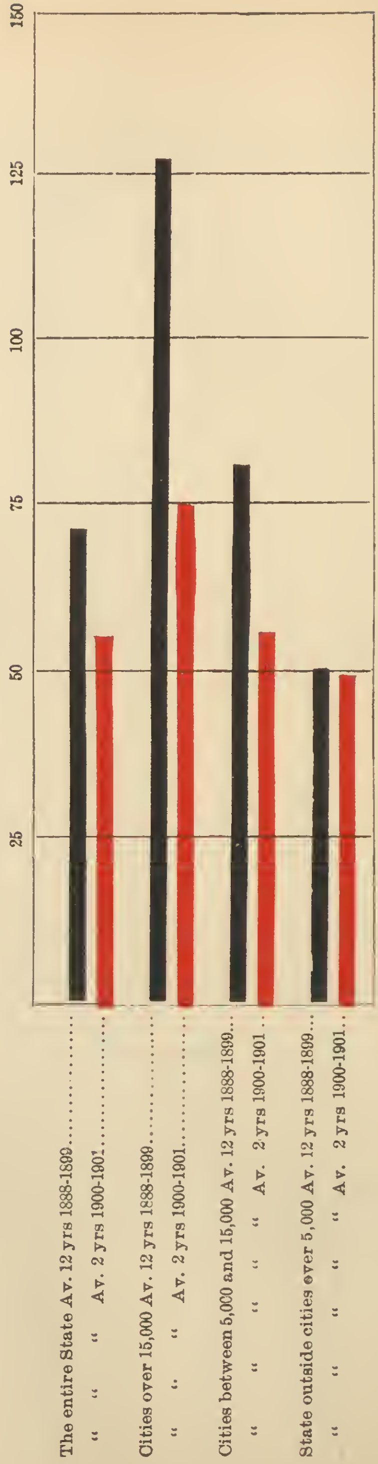
The black section shows the average monthly deaths for eleven years, 1887-1897 inclusive.

The red line shows the average monthly deaths for two years, 1898-1899.

The green line shows the average monthly deaths for two years, 1900-1901.

CHART NO. XVIII.—DIARRHŒAL DISEASES OF CHILDREN.

Deaths per 100,000 Population.



REPORT OF THE CHEMIST.

1901-1902.

MINNEAPOLIS, MINN., Dec. 30, 1902.

Dr. H. M. Bracken, Secretary of the State Board of Health, St. Paul, Minn.

Dear Sir: I herewith respectfully submit a report on the work of the State Chlorine Survey and Sanitary Inspection of the Municipal Water and Ice Supplies to Oct. 1, 1901, including routine laboratory analyses to Oct. 1, 1902.

Respectfully,

HUBERT CAREL,

Chemist.

REPORT OF WATER SURVEY.

The work on the State Chlorine Survey and Sanitary Inspection of Municipal Water and Ice Supplies was continued during the summer of 1901. The appropriation allowed for three months in the field, was sufficient to insure thorough and comprehensive work. This is evidenced by the large number of samples collected and examined. The territory covered was relatively but little greater, but the number of samples (1,012) exceeded by 89 that of the combined numbers (923) of the two preceding summers. In the preparation of an isochlor map, the value of the final statements depend largely on the absolute number of waters upon which these statements rest, as well as the care in selecting and examining said waters. This is especially true in the thickly inhabited portions of our state, where so many apparently good water supplies are fouled by invisible sources of pollution. In several instances waters were collected in territory belonging to previous summers' work and taken at this time to help out the somewhat meagre data for those sections of the state.

The samples include 229 springs, 89 streams, 43 lakes, 155 shallow wells, 82 flowing artesians, 451 non-flowing deep wells, 36 ice supplies. The field analyses consist chiefly of a quantitative determination of the chlorine and a qualitative determination of the nitrites and nitrates, supplemented at discretion by estimation of the organic matter by the permanganate method. The municipal water supplies were examined for ammonias in the laboratory, except in those cases where the field analysis condemned them outright. A certain number of high chlorine wells were also subjected to the ammonia estimation. Samples from the country were taken, not as a direct sanitary measure, but entirely as a means of determining the normal chlorine, hence the ammonias of these waters were seldom estimated.

When the term good, bad, or suspicious is used, it is usually with reference to environment and field tests, not including the ammonias. Naturally, in many instances it was impossible to give any opinion with reference to these waters beyond the *pre-*

sumption as to their quality. Any attempt to take ammonias of all doubtful wells would be practically impossible without a considerably increased field force.

With reference to the selection of samples, the plan of last summer was followed, taking chiefly deep drilled wells, lakes, streams and springs. Bored wells were usually avoided. as they are very uncertain. Dug wells were examined only when the wells in question were exceptionally placed as to environment, or when their analyses were requested by the local officers of health. Wherever possible, samples of the public supplies were taken both from the well direct and also from the tap. These tap samples give evidence of the condition in the water tank.

This report is given under the following headings: "Report by Counties," "Chlorine" and "Laboratory Analyses."

REPORT BY COUNTIES.

OLMSTED COUNTY.

(Including a small portion of northern Fillmore.)

The municipalities of DOVER, EYOTA, ROCHESTER and BYRON were visited during the work of previous summers, and the extreme northeast of the county was worked from PLAINVIEW. The water and ice supplies of CHATFIELD were sent to the laboratory by the local health officer (see 18th biennial report). The country waters, however, were but little known. These were studied, using Rochester, Chatfield and Byron as the working points for their respective districts.

From Chatfield examinations were also made through a strip of northern Fillmore.

Rochester—North of the city samples Nos. 924-940 were taken chiefly from springs and deep wells. Nos. 931, 936-37 and 939 are presumably natural waters, No. 935, possibly so. The others are evidently subject to more or less pollution. No. 933 is something of a puzzle, as its depth was given as 287 feet, of which 283 feet were said to be through solid rock. The analysis, however, is that of a polluted water. Presumably the data as to depth and rock strata were not correct, or possibly surface water infilters from above.

Samples Nos. 941-961 were taken south of Rochester, including the district around CHESTER, PREDMORE, PLEASANT GROVE and SIMPSON. The best waters organically were Nos. 942, 946, 956-57 and 959-60. They gave a uniformly low chlorine, and an absence of nitrous and nitric acid.

The deep wells represented by Nos. 933, 947-48 and 950-51 are not reliable standards for the determination of chlorine, as their environments are not good. Samples Nos. 956-57 are from exceptionally fine springs, coming out of solid limestone.

The Root river is represented by two samples showing very different analyses. No. 961 was taken from a point some twelve miles south of Rochester. The data are good. No. 958 represents the river at a point several miles below No. 961, or about four and one-half miles southeast of Predmore. Here a farmer has constructed a dam of manure and other rubbish, spoiling the water, as shown by analysis. This is an illustration of the constantly increasing tendency to the pollution of streams passing by or through farms.

The city supply at Rochester consists of a mixture of the waters of eleven driven wells and one dug well, together with the surface and subsoil waters located in the sand on the bank of Bear creek. The general drainage of that part of the city naturally flows toward the creek, contaminating the water strata from which these wells draw their supply. Moreover, the Water Works Company have a barn within some 9 feet of the nearest well, and a manure heap within 30 feet of said well. In September, 1899, the water company was advised to remove the barn. It was yet there May 28, 1901. The field analysis No. 964, and the laboratory analysis (L. A.* No. 810), evidence the consequent pollution. These wells do not furnish a water suitable for domestic use, and should be closed. No. 965 is a tap sample taken from the pumping station (L. A. No. 811).

The Rochester ice supply is cut from two sources, Cascade creek and the Zumbro river. Of the two, Cascade creek is considerably the better place, although both give impure waters. (No. 967-68, L. A. Nos. 812, 816.)

The State Insane Asylum at Rochester draws its water supply from one artesian and several shallow wells. The artesian well gave a good analysis; the shallow wells were suspicious. (No. 962-63, L. A. No. 814-15.)

*L. A. refers to Laboratory Analysis. (See table.)

It would be advisable to occasionally test these shallow wells, especially as they are used considerably more than the artesian well.

Byron—A statement as to the village well will be found in the 18th biennial report. The ice supply is taken from a branch of the Zumbro (F. A.* No. 972 and L. A. No. 851).

Samples Nos. 969-88 were taken north of Byron, including specimens at the village of ORONOCO and GENOA. The waters represented by Nos. 969, 977 and 981-82 were evidently polluted; those represented by Nos. 970, 973, 975-78, 983, 988 were suspicious. The remaider yielded passable field data.

Samples Nos. 989-95 were taken south of Byron, and of these the drilled wells, Nos. 991 and 995 were suspicious, both from environment and analyses. The best sample was taken from the well represented by No. 993. The others were bad or suspicious.

The hotel well at Byron (Mr. Jones, proprietor) was condemned in 1899, but was yet in use June, 1901. It is a dug well, 51 feet deep, with a livery stable within 20 feet, and the hotel out-houses within 35 feet. The analysis shows considerable pollution of the water, and the well should be closed. This is but one example of the quality of the water served to the traveling public, and the persistence with which condemned wells are continued in use.

Chatfield—The town water and ice supply of Chatfield were sent in to the laboratory in November, 1900. They were again examined as part of the survey work. The well is some 200 feet deep; through blue clay 20 feet, sandstone 60 feet, limestone 120 feet, and is located on a high bluff 146 feet above the town. There is no visible source of contamination, and the analyses were good. Field analyses Nos. 997-98, and laboratory analysis No. 748, give the analytical data of this well, and of the village tank.

The ice is cut from the Root river, which at this point averages some nine feet wide, and runs shallow over a bed of rock (No. 1002). The sample sent to the laboratory was from the river water, and its data were not good (L. A. No. 749). The field analysis (No. 1002) represents the melted ice, and does not yield condemning data so far as it goes. Nos. 1000-1001 are samples of two shallow wells, both considerably contaminated, and one of

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F. A. refers to Field Analysis. (See table.)

which (No. 1001) supplies the traveling public with drinking water. Nos. 1003-13 are from the country south of Chatfield, chiefly in northern Fillmore county. Their analyses were fairly good, save No. 1011, which had a suspicious chlorine. Nos. 1013-14 and 1020 are samples of fairly good waters to the north of Chatfield. Nos. 1015-17 were suspicious, and Nos. 1018-19 were evidently impure.

GOODHUE COUNTY.

(Also small sections of Dakota, Dodge and Rice counties.)

Zumbrota—The town well is drilled 210 feet; in loam two feet, blue clay 22 feet, and limestone 188 feet. There is a vault within 40 feet of the well, but evidently, from the analysis, pollution does not reach it. (F. A. No. 1038, L. A. No. 853.) No. 1039 was taken from a tap.

The Zumbrota ice is taken from a mill-pond half a mile above the town. Its analyses, as shown in No. 1041 (L. A. No. 854), were fairly good. No. 1025 represents a sample taken from the village well at PINE ISLAND. This well is dug some 15 feet, and drilled 135 feet in sand, gravel, blue clay and limestone. Its nearest contamination is a vault 100 feet away, yet it evidently receives some pollution, as shown by the analysis (L. A. No. 852). No. 1026 represents a sample taken from a tap. The water from the pump, represented by analysis No. 1024, was of still poorer quality. This, however, is from a dug well some 30 feet deep. Waters represented by Nos. 1027-28 are both suspicious.

The creamery well at ROSCOE yields an unusually low consumed oxygen, whereas its chlorine and nitrates point to surface infiltration. If the well were deeper, it would be of sufficient interest to warrant taking the ammonias, but at 30 feet, in an inhabited district, such a water is not usually normal.

Samples Nos. 1030-34 were taken at EAST WANAMINGO. They are of no special interest, and were all more or less contaminated, save possibly No. 1030.

No. 1036 represents a water from a spring at ASPERLAND, some three miles north of Zumbrota. The analytical data are passable. The well represented by No. 1040 yielded a poor analysis. This was said to be a drilled well 80 feet deep; through blue clay 30 feet, rock 50 feet. A barn was within 12 feet of the well,

and either the above data were wrong or there is surface infiltration, as the analysis is not that of a natural water in this part of the state.

Samples Nos. 1044-46 were secured near MAZEPPA, in Wabasha county. The hotel well, represented by No. 1045, is dug 59 feet and drilled 20 feet. The hotel vault is some 40 feet distant on the down slope. The analysis of this well suggests small infiltration. The ice supply is taken from the Zumbro river (No. 1045), and its analysis is not good. This river water is also pumped for fire protection.

At GOODHUE four samples were taken. No. 1448 represents the old town well, and No. 1449 the new well, both of which yielded fairly good analyses. The Goodhue Creamery well (No. 1050) yielded an unusually high chlorine for this part of the country. The depth was given at 208 feet, and chiefly in the limestone. In the absence of any more analytical data, an opinion as to this water should be guarded. The nitrates point to former pollution.

No. 1052 represents the village well at RICE. It is a dug and driven well, some 13 feet deep, into drift. Its analysis is suspicious. The well represented by No. 1054, in Zumbrota, is presumably polluted. Its depth was not given.

Red Wing—The city has no municipal water works. Its ice supply is cut from the Mississippi river. The Poor Farm, the railroad companies, and many of the manufacturing plants are supplied by private wells. A number of these wells are fine flowing artesians, yielding analyses similar to the waters of Houston and Winona. The chlorines were high, and presented considerable variation. The free ammonias were also high, but otherwise the analyses gave no evidence of organic infiltration, either past or present. These wells are represented by field analyses Nos. 1055-57, 1060-65, 1093 and 1095-97, inclusive. They were all examined in the laboratory, and will be found under Nos. 910-920 They are also discussed under "Chlorine."

Hay and Spring creeks, the Cannon river and its branches, represented, respectively, by Nos. 1059, 1066, 1071 and 1073, were all evidently polluted, as shown by the salts of nitrous and nitric acids present. The series of deep drilled wells, represented by Nos. 1080-1088, yielded thoroughly good analyses, except No. 1084, which gave somewhat suspicious partial data, and should again

be examined in the laboratory. The State Training School well is located on the river bank, far from any visible sources of pollution. Moreover, there are no cess-pools or out-houses on the grounds, yet it yielded a high chlorine and strong nitrate reaction, which indicates past pollution. This possibility is further borne out by the free ammonia shown to be present (L. A. No. 921). Other analyses are necessary before forming a final opinion of this water. The well represented by No. 1102 was near WACOUTA. It is entirely in the rock, but evidently receives infiltration through the rock crevices. The drilled well at the Lutheran Ladies' Seminary, represented by No. 1001, yielded passable field data.

Cannon Falls—The public well, represented by No. 1122, is drilled 203 feet; in limestone 143 feet, and in sandstone 60 feet. It is used for fire protection only. The sample was taken from the tank. The ice supply is cut from the Cannon and Little Cannon rivers. No. 1125 represents melted ice from the Cannon river, and No. 1124, the Little Cannon river water. Both showed the presence of nitrates, indicating up-stream pollution. Samples Nos. 1103-25 were taken in and south of Cannon Falls. The purest waters were from two excellent flowing wells in the village (Nos. 1103-4). These wells are, respectively, 404 and 416 feet deep; in drift 60 feet, limestone 200 feet, sandstone and shale 156 feet. Both send forth a heavy stream; the one represented by No. 1104 especially, which rises 50 feet above the surface.

A number of wells sampled in this district were dug part way and drilled the remainder. This very often admits surface drainage, as shown by their analyses. The dug well represented by No. 1112 is at WASTEDO, as is also No. 1113. The former has a high chlorine, due, presumably, to a near-by out-house. No. 1119 is an analysis of water from the village well at WHITE ROCK. This well is dug 25 and drilled 35 feet. It is situated in an alley, with the usual surroundings, and its analysis condemnatory. Most of the wells sampled south of Cannon Falls were in more or less suspicious environments, and not sufficiently deep to escape pollution. They represent, however, the best wells of the district.

At NEW TRIER, some eight miles south of Cannon Falls, the village well was sampled, and its analysis, as shown in No. 1129, was passable so far as it goes. Samples Nos. 1131-32 were from HAMPTON wells, and both gave passable analyses. No. 1134

represents another fine flowing well near Cannon Falls. No. 1135 represents an undoubtedly polluted well.

Reviewing the entire Cannon Falls series, the following should be condemned by the field analyses: Nos. 1105, 1112, 1117, 1119-21, 1123, 1126 and 1133. The following were suspicious, and should be examined in the laboratory: Nos. 1108, 1111, 1113-14, 1116, 1124-25 and 1130. The others passed the field tests.

Kenyon—The village well is 20 feet deep and 16 feet in diameter; in loam and clay 10 feet, limestone and clay 10 feet. Its analysis, as shown in No. 1175, is that of a polluted surface water (L. A. No. 855). Three other shallow wells, one creek and a spring were examined by request. These are represented by Nos. 1176-80, and all evidenced contamination. One represents the supply served to the traveling public (No. 1180, L. A. No. 859).

The creamery well at SKYBERG yielded a good analysis (No. 1158). Samples were also taken at FAIR POINT and OLD CONCORD (Nos. 1160-63). The last two were evidently contaminated. At WEST CONCORD both dug and drilled public wells yielded the data of pollution. Nos. 1164 and 1167 gave good analyses. Of the MOLAND samples, Nos. 1169 and 1173 were the best. The others were suspicious.

RICE COUNTY.

Northfield—This city was visited twice, and its analyses may be found under Nos. 1135-54 and 1203-27. The municipal supply is derived from a very fine flowing well, 647 feet deep, with the following stratification:

1.		2.	
Loam	4 ft.	Sandstone	20 ft.
Limestone.........(flow)	265 "	Shale	3 "
Sandstone ....(flow)	50 "	Sandstone	15 "
Shale	225 "	Shale	9 "
		Sandstone ....(flow)	35 "
		Limestone	25 "

The analysis is shown under No. 1203 and L. A. No. 860.

The ice supply is cut from the Cannon river, which is represented by No. 1205, showing nitrites and nitrates, the evidence of sewage contamination. The sample of melted ice did not yield

such an analysis (No. 1227, L. A. No. 861). Ice never yields as bad an analysis as the water before freezing, yet we should expect a trace of the aforementioned salts. Probably the pollution is of an intermittent nature.

West of Northfield samples Nos. 1135-54 were taken. They represent country wells in the villages of WHEATLAND, LESTER and DUNDAS. Wells represented by Nos. 1135, 1144, 1148, 1153-54 should be condemned, and wells represented by Nos. 1149 and 1152 should be considered as suspicious in quality. The two lakes, Circle and Fox, represented by Nos. 1150-51, would make fairly good sources for ice supplies. Union lake, represented by No. 1138, is rather small. There was, however, no visible contamination, and its nitrates may be of vegetable origin.

Samples Nos. 1223-27 were taken partly in the city and partly in the country to the east and southeast. A heavy storm curtailed the number of out-of-town samples, but enough were taken to show the country chlorines. The best of the wells are represented by Nos. 1203-4, 1209, 1214-15, 1221-22, 1225 and 1227. Wells represented by Nos. 1205, 1208, 1210-11, 1220 and 1223 should be condemned. The others would come under head of suspicious wells.

Faribault—Faribault water supply is represented by Nos. 1181-1202 and 1228-52. The city is supplied by a mixture of water from two deep and two shallow wells. The deep wells are, respectively, 675 and 1055 feet deep, through drift, limestone and sandstone. The shallow wells are each 20 feet deep in the drift only. All the wells are located in a valley, with a barn 18 feet, one vault 100 feet, and another vault 125 feet distant. In addition, there is a railroad drain some 300 feet above, where in wet weather a slough is formed.

The engineer of the Water Works Company stated that the shallow wells drained from a radius of 200 feet, as shown by the formation of a dry zone when pumped. This radius thus includes the barn and both out-houses.

A sample of the deep wells, unmixed with the surface waters, could not be obtained. No. 1195 represents the mixture of both deep and shallow wells. Nos. 1196 and 1197 are analyses of the shallow wells separately (L. A. Nos. 858-9). These last analyses, as indicated, especially the ammonias and nitrates, show the pollution of these surface and subsoil waters, and these shallow wells

should be closed to public use. The deep wells are evidently quite pure, as evidenced by the low ammonias of the mixture (L. A. No. 857). No. 1201 is an analysis of melted ice secured at Faribault. Its data are passable.

Samples Nos. 1181-84 and 1198-1200 represent certain shallow wells in the city. They give the usual analysis of surface and subsoil waters in an inhabited district, and account for some of the typhoid fever prevailing among those who use these waters as a source of supply.

Among the country samples represented by Nos. 1185-94 two are especially bad, Nos. 1185-86, and the others are more or less doubtful. It is instructive to note the increased chlorine in the Straight river at WOLCOTT (.45 parts, No. 1190) over and above what was found in it at Owatonna, some 15 odd miles above. (See 18th biennial report, F. A. No. 573.)

There are a number of fine lakes suitable for ice supply near Faribault, especially Cannon, Cedar, Fox and Roberts lakes, and Lake Mazaska, represented, respectively, by Nos. 1228, 1230, 1245-46 and 1242. (L. A. No. 863-5.)

The spring at SHIELDSVILLE, represented by No. 1243, is used as drinking water for this little summer resort. It would probably be a good water if the pigs were kept away, but its present analysis is bad.

Aside from the lakes mentioned above, the following waters gave passable data: Nos. 1231-32, 1234, 1237-41, 1244, 1248 and 1250-52.

LE SUEUR COUNTY.

(Including a portion of East Nicollet county.)

Le Sueur—The city well flows from a depth of 667 feet through clay, gravel, blue schist and white sandstone. It gives a very fine quality of water, yet yielding a high chlorine. The field analyses of both wells, direct, and a tap sample, are shown under Nos. 1257-58, and would indicate a dirty tank, as shown by the increased "consumed oxygen" and presence of "nitrates" in the tap water. The laboratory analysis is shown under No. 866.

The ice supply of Le Sueur is cut from two points in the Minnesota river, one a mile above, and the other a mile below, the city sewer. The analyses of the river water taken at that point

are given under Nos. 1255-56. The effect of the St. Peter, asylum and city, sewage is plainly shown in the nitrates and nitrites of analysis No. 1256, and the increased pollution due to the Le Sueur sewer is shown by the increased chlorine and nitrites of No. 1255. The analysis of the ice itself (No. 1278, L. A. No. 867), is distinctly bad, showing the presence of both nitrites and nitrates.

Samples Nos. 1253-78 represent water taken in Le Sueur City and the northern part of Le Sueur county, including the villages of LE SUEUR CENTRE, LEXINGTON and ST. THOMAS.

At LE SUEUR CENTRE the village well is some 240 feet deep, in loam, clay, gravel and rock. There is a barn some 25 feet distant, but the field data give no evidence of any infiltration (No. 1267). Likewise the court house well yielded passable field data. There is, however, an out-house some 100 feet away, which may in time pollute this water. The Le Sueur Centre jail is supplied by a dug well some 46 feet in loam and clay. The jail building is within 10 feet, the visible out-house within 100 feet of the well. Analytical data condemn this water, as evidenced by the high chlorine and strong nitrates.

Other bad specimens from dug wells are shown under Nos. 1272-73, taken in St. Thomas, and in the country (Nos. 1274-75). The spring in Le Sueur represented by No. 1254 should be condemned as a source for drinking water, and likewise Le Sueur creek (No. 1262). No. 1270-71 are specimens from the same lake, one taken in its center, the other immediately over a large spring coming up from the bottom. With the exception of No. 1259, which is suspicious, the waters of the Le Sueur series yield passable data.

St. Peter—The water supply at St. Peter is from a combination of dug and drilled wells. The supply came formerly from the dug well alone, but later the drilled well was put down in its center. Most of the water comes from the drilled well, which is a flowing water of fine quality, coming from a depth of 200 feet. A certain percentage of the supply, however, comes from the old dug well, and, as it is situated on the river bank, it must receive some of the town drainage, but how much it is difficult to determine, as it was not possible to obtain an unmixed sample of this water. The tap analysis (No. 1339) was, however, practically the same as that of the sample direct from the artesian well (No. 1338), consequently the quantity of surface water going in must be com-

paratively small. This is further borne out by the laboratory analysis (L. A. No. 873). The free ammonia is very high, but that is not a condemning datum in a deep well. This is a supply which should be watched by means of an occasional analysis. A poorly constructed sewer runs within half a block of the well, and its contents may some day be a source of contamination, and, moreover, as the town builds more and more directly behind and around the well, the surface and subsoil drainage will surely reach the water. At present, however, the analysis is good (Sept. 14, 1901).

The ice supply of St. Peter is cut from the Minnesota river, about one-half mile below the city sewer and two and a half miles below the State Insane Asylum sewer. Analyses of melted ice are shown under No. 1319, this series, and L. A. No. 871. They give chemical evidence of the filthy condition of the stream. There are so many lakes in Le Sueur county that it is entirely unnecessary for the cities of St. Peter and Le Sueur to use polluted points from which to secure their ice. In years past some ice was cut from Lake Emily, but of late the supply for St. Peter has come entirely from the river. The analysis of Lake Emily is given under No. 1310 (L. A. No. 869). There are two little summer resorts on this lake which, of course, affect the purity of the water to some extent, but the ammonias shown were without doubt chiefly of vegetable origin.

In OTTAWA and vicinity three large flowing wells were sampled. These are also considered under "Chlorine" (Nos. 1284-86). Among the other waters to the northeast and southeast of St. Peter those evidently contaminated are shown by Nos. 1303 and 1309. Those of suspicious analyses are shown by No. 1295 and 1311. The remainder passed the field examination test. Some of the chlorine reactions from springs were a trifle high, as for example No. 1282, yielding .60 parts per 100,000, and a more complete analysis might condemn these.

The State Asylum for the Insane at St. Peter is supplied by the waters from three large flowing wells, of which both the environments and analyses were good (Nos. 1316-18 and L. A. No. 870). West of St. Peter, Nos. 1321-37 were taken, including samples from LANGE, OSHAWA, NICOLLET, NORSELAND and TRAVERSE. The village well at Traverse gives a surface and subsoil water showing considerable contamination (No. 1336), and the drilled wells represented by Nos. 1333 and 1335 are suspicious. The other analyses yielded passable field data.

BROWN COUNTY.

(Including south Nicollet, northeast Cottonwood and southeast Redwood counties.)

New Ulm—The waters from New Ulm and vicinity are represented by Nos. 1432-38 and 1925-34. The city is supplied by three drilled wells, each 200 feet deep, and yielding a somewhat peculiar analysis. This consisted of a high chlorine, a trace of nitrites and a large amount of free ammonia (Nos. 1428-30, L. A. Nos. 877-79). A high chlorine and a similar amount of ammonia was given, also, by two other deep well waters in the vicinity (Nos. 1431 and 1435, L. A. Nos. 880 and 882). These wells are located on higher ground and are deeper. They did not yield nitrous acid, nor was their chlorine so high, although 4.0 and 8.0 parts per 100,000. They are, respectively, situated about one-half mile and a mile and a half from the city water works, on higher ground. Several springs within the city limits, and one at each of two breweries on the outskirts of New Ulm yielded, also, a high, but diminished, chlorine (L. A. Nos. 1432-33, 1436-40 and 1482).

All of these springs yielded nitrates, the evidence of former organic matter, and several yielded, also, nitrites. The ammonias of two were determined (Nos. 1433 and 1482, L. A. Nos. 881 and 885). In both cases these data were low.

A large number of available wells and springs were sampled in the vicinity of New Ulm, but the only high chlorine was that of an evidently contaminated street well at COURTLAND. These New Ulm waters will be further considered under "Chlorine." Their analyses are evidently peculiar, but we should hesitate to condemn them. They should be kept under observation on account of both their position and their nitrites.

The tap sample at New Ulm (No. 1441) showed higher chlorine than any one of these wells. It yielded, also, nitrates and increased nitrites. The tank evidently needed cleaning. The ice supply at New Ulm is chiefly from the Minnesota river. The laboratory analysis was made from a sample of the river water at the bridge where the ice is cut. The data given under No. 884, laboratory analyses, and No. 1481 of this series, are those of a considerably polluted stream, entirely unfit for domestic use. Moreover,

not only is this ice served to the people of New Ulm, but it is likewise shipped to the following cities, towns and villages:

Winthrop,	Klossner,	Evan,
Fairfax,	La Fayette,	Morgan,
Sleepy Eye,	Gibbon,	Wanda.*

A portion of the ice is said to be taken from the Big Cottonwood river. A partial analysis of this stream is given under No. 1442, and it is not condemnatory. Its chlorine, however, was suspicious, but may have been of natural origin.† Among the other analyses of the first New Ulm series, Nos. 1443, 1446, 1449, 1453, 1460 and 1469-71 yield condemning or suspicious data.

The second New Ulm series was taken at the end of the season in another attempt to find some country wells comparable with the city supply. The wells examined were along the Minnesota Valley west, and on the prairie north and northwest of New Ulm, but no high chlorines were obtained. This may be accounted for by the fact that none of these wells were deep enough to reach the water stratum of the New Ulm supply.

Sleepy Eye—The village well was condemned some years ago, but is yet in use. Its present partial analysis is given under No. 1398, L. A. No. 875. The school well was also condemned some time ago, but it is still in use also.* The ice supply is partly from New Ulm, partly from the Cottonwood river.

The bottling company at Sleepy Eye takes its water supply from a very dirty shallow well (No. 1402), with a refuse heap near at hand. This filthy water is used as a basis for the bottled products which are sold in Sleepy Eye and neighboring towns. This well should be closed. The bottling company has a deeper well on its premises, but this well is not used for bottling purposes. Other evidently contaminated waters in and about Sleepy Eye are represented by Nos. 1401, 1396, 1419, 1422-23 and 1427. Suspicious analyses were yielded by Nos. 1338, 1390-91, 1393, 1396, 1410, 1413, 1420-21 and 1426. The remainder gave fairly good field analyses, and some of them will again be considered under "Chlorine."

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*This list is given on the authority of Mr. F. Behnke, ice dealer.

†Later laboratory analysis condemns this water.

*A recent laboratory analysis of the school well, given under No. 876, shows marked improvement in its quality, but the village well is as bad as ever.

Springfield—The public well at Springfield is used only for fire protection. It is a shallow flowing well, 33 feet deep, and so covered that samples from the flowing water itself could not be obtained. No. 1496 is the analysis of a sample from the tank, which is probably dirty, as shown by the presence of nitrites and nitrates. Directly across the street is the bottling company's flowing well, 21 feet deep, which gave the same chlorine, but no nitrous or nitric acid (No. 1497 and L. A. No. 889). The Springfield ice supply is from the Cottonwood river. The melted ice yielded analysis No. 1498 (L. A. No. 890). Samples Nos. 1483-94 and 1499-1502 represent country wells and springs. Most of the available waters are comparatively shallow wells. They gave, however, satisfactory analyses (Nos. 1483-84, 1492, 1494 and 1502-3). The others were more or less suspicious.

REDWOOD COUNTY.

(Including north Cottonwood and a small part of northeast Lyon and of southwest Renville counties.)

Redwood Falls—Several fine springs, located at a distance from all contamination, form the city water supply. Their analyses are shown under Nos. 1376-79. At the time of examination the water was fouled by standing in a very rotten tank. Not long afterwards this tank naturally collapsed. The tap analysis is given under No. 1380.

The ice supply is taken from the polluted Redwood river. In the 18th biennial report, the filthy condition of this stream at Marshall, which is above Redwood, is set forth. Its analysis is again given under No. 1381.

Forty-two samples were taken in Redwood Falls and the surrounding country district. The waters to the southwest are represented by Nos. 1340-51. They are types of the shallow wells, etc., supplying the country. Nos. 1342, 1344 and 1349 gave a passable field analysis. The others were all more or less condemnable.

East and southeast of Redwood Falls, better samples were obtained. These were chiefly from springs, as there were very few acceptable wells. At MORGAN the village well was evidently polluted, as shown by its own chemical analysis, and also by comparison with the analysis of the mill well, which reaches

exactly the same depth, and is situated on the same elevation, but a few hundred feet distant. Nevertheless, it yielded excellent analytical data (Nos. 1367-68).

No. 1373 was taken at GILFILLAN. The well supplies drinking water to the Gilfillan farm. It is a bored well, banked on top with manure. No. 1370, supplying the Davison farm table, is even worse. Aside from those mentioned, the analyses of Nos. 1356, 1360, 1364, 1366, 1369 and 1374 are not good.

Sanborn—The village well, 300 feet deep, is represented by No. 1505, L. A. No. 890. The sample was obtained from the reservoir, and was fairly good for a deep water. No. 1506 represents a bored well, examined by request of the local health officer. It is some 32 feet deep, in clay and gravel, with an out-house 40, and barn 50, feet, distant. Evidence of contamination was shown by the analysis.

Revere—The old town well (No. 1507) flows from a depth of 190 feet, and yields a small supply of fair water. The new flowing well, 250 feet deep, gives a satisfactory analysis for artesian water in a salt district (F. A. No. 1508, L. A. No. 892). The old well is but little used. The flowing wells, represented by Nos. 1509-1518, were taken in the country about Revere, as part of the chlorine survey. The field data for the entire series were good, save and except only No. 1514, which represents a tank sample, and its nitrites and nitrates are probably due to accumulated dirt.

Walnut Grove—Samples Nos. 1519, 1522 and 1542-56 were taken in the village and its environing country. The public water supply comes from a drilled well 215 feet deep in loam and clay. The sample (No. 1553, L. A. 900) was taken from the tank, which is probably dirty. Water direct from the well could not be obtained at this time, as there was no direct connection. In 1898, however, water from this well was examined and passed as fairly good. However, the tank should be thoroughly cleaned and a fresh sample of water sent up for analysis, as a change may have taken place since then. The school well gives a flowing supply. It is about 290 feet deep. The analysis of the water suggests the probability of a dirty tank (No. 1554). No sample could be obtained from the flow directly, as the water ran into an underground tank cemented over.

The Walnut Grove ice supply is cut from Plum creek, a small stream, probably polluted, as shown by the presence of nitrous

and nitric acid (No. 1543). The melted ice yielded analysis No. 1556.* Samples Nos. 1519-22 and 1544-52 represent deep drilled wells, some of which were flowing, taken in the country near Walnut Grove. (See "Chlorine.") Of these Nos. 1548 and 1546 gave a suspicious reaction.

Lamberton—The city well is drilled 620 feet; through loam four feet, clay 200 feet, white morrow 80 feet, red sandstone 436 feet. However, but little water is obtained at this depth. Most of the supply comes in at 180 feet. The environment is very bad —a dirty alley, with a manure pile and out-house some 30 feet away. Part of its chlorine is undoubtedly due to natural conditions (see "Chlorine"), but strong nitrites and nitrates gave evidence of sewage infiltration (No. 1554, L. A. No. 897). No. 1529 is a tap analysis.

The ice supply was from the Cottonwood river, and its field analysis (No. 1530) is passable. The deep drilled and flowing wells, represented by analyses Nos. 1523, 1526-28, 1531-32, 1535-37 and 1540-41, were all fairly good. No. 1533 is finely located, and some 230 feet deep, through yellow and blue clay, with a barn some 90 feet distant, on a decided down slope. The strong nitrites in this water are probably due to denitrifying processes, but before passing final judgment the ammonias should be taken. A laboratory analysis will be made if a sample of water is sent in. Likewise of Nos. 1534 and 1538.

Vesta—The village has no municipal well, and the work done here was chiefly a chlorine study, which the scarcity of deep wells considerably curtailed. The ice supply is taken from the Redwood river, which at this point yielded a fair analysis. The wells represented by Nos. 1562-1563 were presumably polluted.

Delhi and Echo—The village of Delhi has no public well, and the one at Echo is used for fire protection only (No. 1576). The ice supply comes from the polluted Minnesota river at Morton (No. 1575). There were practically no deep wells near either village, save those represented by Nos. 1564 and 1570. The water represented by Nos. 1571 and 1574 gave condemning data.

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*These two analyses are instructive as showing the great variation in the quantity of creek pollution. Ice always yields a much smaller percentage of solids, yet here chlorine is greater in the melted ice sample. Moreover, the salts of the nitrous and nitric acid often entirely disappear in the ice. These analyses are so entirely different that they would not be looked upon as coming from the same lake, or even from similar waters.

RENVILLE COUNTY. (Southern Part.)

Morton—The village has begun a water works system, to be supplied by springs. The springs were being cleaned out at the time of inspection, for the village, and a good sample of the water could not be obtained. However, the spring at Thos. Leary's place comes out of the same bank, and yields a good field analysis (No. 1577).

A number of spring and drilled well samples were taken near Morton. Analyses of the spring samples were often influenced by the presence of milk cans in the water, which may account for a large number showing nitrites and nitrates. Drilled wells were few and far between, and none over 156 feet deep. The best water samples were Nos. 1577, 1580, 1583, 1585, 1587, 1589-90. 1599-1602, 1603, 1607 and 1610.

At the request of the local health officer a few of the dug wells were examined. Two of these were at the railway eating house known, also, as the Commercial Hotel. No. 1596, which supplies the hotel guests with drinking water, has a cess-pool within 70 feet. Its analysis was naturally that of a highly polluted water, nevertheless it will continue to be used as a supply for the traveling public until the village water works are in running order. The other well at the hotel (No. 1595) was used for laundry purposes, and was equally bad.

The Revere Hotel, which is a rooming house, was supplied by another driven well, 30 feet deep, and yields even a worse analysis (No. 1597). The soil and subsoil here consists of loam and clay six feet and the balance sand and gravel. The fourth shallow well examined in Morton was that represented by No. 1598. It was dug 24 feet in loam and gravel, with a closet 12 feet, and barn 20 feet, distant. Analysis was very condemnatory.

Franklin—The village well is drilled 122 feet in loam, clay, muck and gravel, with nearest out-house 150 feet distant. Its analysis was fairly good (No. 1609). The ice is cut from the Minnesota river, of which the analysis is given under Morton (No. 1604).

Fairfax—The town well is drilled 170 feet deep in loam, clay, hard pan and gravel. The nearest contamination was a manure pile within 30 feet and a closet within 50 feet. At the time of examination, the water was not used for drinking purposes, but

whenever it is another analysis should be made (No. 1620). The tap sample (No. 1619) showed a dirty tank. Nos. 1615-16 are analyses of two dirty dug wells, examined by request. The wells represented by Nos. 1618 and 1631 likewise showed pollution. Of the country samples the tests would pass Nos. 1621-22, 1626-28, condemn Nos. 1624-25, and class Nos. 1623 and 1629 as suspicious. The creamery well (No. 1630) was similar to the town well in depth and analysis.

SIBLEY COUNTY.

(Including parts of Northern Nicollet and southwestern McLeod.)

Gibbon—No. 1635 represents a sample from the Gibbon tank. The well itself is drilled 207 feet in loam, clay and gravel, and is used chiefly as a fire protection. The ice supply was partly from Lake Minnetonka and partly from New Ulm. Samples Nos. 1636-37 are from the deep drilled wells in the village. Nos. 1638-45 represent drilled wells in the environing country. The best of these are Nos. 1637-38 and 1640.

Winthrop—The city obtains most of its water for domestic purposes from shallow dug or driven wells. It has a good municipal well, but the pipe is so small that comparatively little water can be obtained from it, and almost none is used for the householders. The well is driven 240 feet through loam and clay. The environment, including several closets, a barn and a dirty back alley, is bad, but pollution does not reach the water at present, as evidenced by its analysis (No. 1633, L. A. No. 903). The filth surrounding this well should be cleared out before extending the use of this water because of possible infiltration. The city tank was in very poor condition, as evidenced to the eye, and likewise shown by the analysis (No. 1634).

A considerable number of shallow wells were examined at the request of the city council and some individual citizens. They included the two hotel wells, school house well, and a number of private wells. In most cases the analysis was evidently superfluous, but was made to satisfy the interested parties.

These waters are represented by samples Nos. 1666 and 1668-90, inclusive, which gives a total of 24 domestic and public supplies, every one of which evidenced more or less contamination. This, of course, is to be expected from shallow wells in an inhabited

district. This report was given to the mayor of Winthrop, and was used, we understand, to aid in securing an issuance of bonds for a public water supply.

The mill well (No. 1667) was evidently of good quality. The Winthrop ice was shipped in from New Ulm. The country wells about Winthrop are represented by samples Nos. 1647-65. Of these, Nos. 1649, 1654, 1656 and 1665 show a suspicious reaction.

Gaylord—The village well is drilled 302 feet through sand, gravel and clay. It is used only for fire protection, and its analysis was good (No. 1738). The Gaylord ice is cut from Lake Titlo (No. 1715), a shallow drift lake of about 1,000 acres area. At times a supply is obtained from the south shore of High Island lake (Nos. 1702 and 1706, L. A. No. 904). This lake is considerably larger than Titlo, but has the village of New Auburn and its cemetery on its shore. Neither lake should be recommended for supplying ice, but of the two High Island is the better, because of its greater volume.

Samples Nos. 1691-1736 include country waters taken to determine the chlorine. Nos. 1718-21, inclusive, were from shallow wells, sampled by request, and show more or less contamination. Nos. 1697-98, also, represent contaminated dug wells. Aside from these the country well samples yielded fairly good analyses, and some of them were excellent. No. 1693, however, could be classed as suspicious; the well probably was not 160 feet deep. No. 1737 was from a deep well in the village, taken to compare directly with the municipal well.

Arlington—At the request of the local health officer, certain shallow wells were examined. They are represented by Nos. 1783-88, and were all bad. They include the three hotel wells, and the street corner well, widely used and known as "The Town Well" (No. 1787). The ice is cut in Silver lake, a small elongated drift lake, which yields rather high chlorine. It should receive laboratory examination. Samples Nos. 1739-83 were from various points near Arlington. Three were from GREEN ISLE (Nos. 1774-76), and represent fairly good waters. Among the country samples, Nos. 1757, 1760, 1766, 1799 should be condemned, and Nos. 1740, 1768 and 1781 classed as suspicious. The drilled well, represented by No. 1780 (Mr. M. Fahey), represents an unusual water, yielding high mineral residue, and, on shaking, a decided lather. (See "Chlorine.")

Henderson—The city well flows from a depth of 700 feet, and yields an excellent analysis (No. 1806, L. A. 905). It is but little used by the people, who are largely supplied by a dug well. Two of these dug wells were examined, to-wit: the one at the Merchant's Hotel (No. 1804) and the livery stable well (No. 1805), used for table water at the Hoffman House. Both were condemned, and reported to the local health officer.

Henderson ice comes from a narrow elongated body of water called Berles lake. It is a very small lake, indeed, and a cow pasture extends down to the water. Contamination is shown (No. 1790). Samples Nos. 1791-1803 were taken in the country about Henderson. The brewery spring (No. 1789) was apparently subject to some surface infiltration, but it should not be condemned without a more complete analysis. The nine drilled wells, represented by Nos. 1791-97 and 1800-01, are uniformly good. Presumably those represented by Nos. 1799 and 1802 are also natural waters. Their analyses do not correspond closely with the series of the nine, but, so far as can be judged from the depths given and the field data obtained, they would be accepted as passable.

SCOTT COUNTY.

(Including part of east Sibley and the northwestern edge of Le Sueur counties.)

Belle Plaine—The public water supply was from a drilled well, 200 feet deep, located at the intersection of the two principal streets. Its analysis was fairly good, as shown by No. 1811. (See, also, 18th biennial report.) The high chlorine (1.7 parts per 100,000) is presumably due to natural causes, but may come, in part or wholly, from ancient contamination, as suggested by the nitrates. On request of the local health officer a special examination was made last summer of the tank at Belle Plaine. It was shown at that time, both by personal inspection and chemical analysis of the water, that the tank was entirely unfit for use. (See 18th biennial report, L. A. Nos. 494-5.) The same tank was still in use Sept. 12, 1901. Analysis of the water after standing but a short time in said tank demonstrated its rotten condition, as shown by the formation of nitrites. The ice is cut from a small pond known as Hopper's lake (No. 1824).

Among the waters sampled in and around Belle Plaine, the following gave the best analyses: Nos. 1810, 1816, 1820, 1822, 1824, and 1827. Several reputed deep wells yielded nitrites and nitrates, and should not be endorsed without a second analysis from the laboratory.

Jordan—The town has no public water supply. The ice is cut from two dams in Sand creek. The upper dam is about half a mile south of the town, with no observable contamination. Its analysis is given under No. 1846. The lower dam, however, is subject to some out-house and cattle pollution, and its analysis (No. 1882) is distinctly bad. Wells represented by Nos. 1879-81 were examined at the request of the local officer of health. The Merchant's Hotel well showed good field data. The dug wells, one of which supplies the traveling public at the American House, were bad. The country wells south of Jordan are represented by samples Nos. 1846-53. Except Nos. 1849-50, the analyses were passable. North of Jordan the country waters are represented by Nos. 1857-64. Of these, Nos. 1858-59 and 1862 were suspicious. East of Jordan the country waters are shown under Nos. 1872-78, of which but one yields a suspicious analysis (No. 1874). At the time of this inspection a small stream named Sand creek, passing through the place, was polluted to the extent of being a public nuisance. The water of this creek is held back by two dams. What little water passes through the dams runs on through the town where the stream is used as a public sewer. The sewage includes waste from two breweries and a creamery, to which is added a large number of out-houses and a series of domestic drains. The filthy condition of this stream is probably as bad as can be found anywhere in the state. The multifarious odors, especially those from the brewery waste, spread for blocks over the village. The attention of the local board of health was drawn to the matter, and a report was also sent to the State Board of Health at St. Paul.

New Prague—Samples Nos. 1854-56 were taken at New Prague. The city well is drilled, 390 feet deep, and yields a good analysis (No. 1855, L. A. No. 906). The water is used but little. The tap sample (No. 1856) was taken from one of the stores, and its nitrates are probably accidental, as the tank had been cleaned but a few days before. New Prague ice is cut from a small pond within the corporate limits, and partly surrounded by houses. Its

water is green with the vegetable life, and its analysis (No. 1854) evidenced contamination.

Shakopee—Samples Nos. 1865-69 were taken in Shakopee. The city has no public water supply, and its ice is cut from the Minnesota river. Its analysis (No. 1865 and L. A. No. 907) are not good, even though allowance is made for its chlorine as coming from the natural brines of Belle Plaine. The well, represented by No. 1869, and taken three miles northeast of Shakopee, is apparently contaminated, as evidenced by its chlorines and nitrates. Ten miles southeast of Shakopee a sample of the Prior lake water was taken, some 300 feet off shore, at the summer resort of GRAINWOOD. The ice supply of the village of PRIOR LAKE is taken from this place, as is, also, the ice supply for the Grainwood hotel. The analyses of the waters are shown under Nos. 1871 and L. A. No. 908. The village well at Prior Lake is represented by analysis No. 1870 and L. A. No. 909. Nos. 1873-78 were taken from the Prior Lake and Jordan. The field analysis of this entire series, Nos. 1870-78, are acceptable, save only No. 1874.

POPE COUNTY.

Glenwood—As previously explained, these samples were taken out of the regular line of work. There are a large number of springs in the vicinity of Glenwood, especially near Lake Minnewaska (Whipple), and a majority of them were examined. The work is of especial interest, as showing increased chlorine in Lake Minnewaska over the highest chlorine of any spring or well sampled on or near its shores. This would lead to the inference that even so large a body of water as this lake shows an appreciable infiltration of sewage from the villages of Glenwood and Starbuck. Moreover, there is no sewerage system discharging into the lake, but only the usual surface drainage and subsoil infiltration. The series of spring analyses is exceptionally uniform in character and purity, especially those for all between Nos. 1890 and 1916. They were taken for several miles on the east and on the west shores of the lake.

The public supply is derived from two large springs coming out from an elevation overlooking the city. They are known as tank and reservoir springs, and represented, respectively, by Nos. 1921 and 1922. They yielded an exceptionally low chlorine and a general excellent spring analysis. At the time of the visit this was

all spoiled by permitting the waters to collect behind an ancient wooden dam, forming an open pond, covered with green slime and a variety of vegetation, not to speak of the old boards, sticks, etc., floating around. The analysis of this pond or reservoir, formed entirely by these two springs, is given under No. 1920 (L. A. No. 886). Recently, however, all this has been cleaned out, and a new reservoir is under construction.

CHLORINE.

The Chlorine Survey for the summer of 1901 was carried on with as great a degree of thoroughness and completeness as was judged consistent with all requirements as to accuracy, and yet with a view to proper economy of time and money.

The mere figure of 1,012 samples collected and examined will give some idea of the amount of work done, when it is remembered that every individual sample was considered as to its local conditions, and, wherever possible, its geological strata.

For the sake of brevity, but few statements as to strata are given in this report, but a record is kept of all data given, and these records will be used in the general preparation of the State Isochlor map when the field work has been finished.

As in previously studied parts of the state, a general normal chlorine, extending over the greater part of the territory covered, has been found, but broken here and there by areas showing high chlorine in certain classes of waters. Extremes of chlorine run from .05 parts per 100,000 in the Glenwood springs, to 32.0 at the Red Wing Poor Farm.

Thus far, high chlorine has been traced up the Mississippi valley from Houston to Red Wing, also in the Minnesota valley from New Ulm to Belle Plaine, and far below the surface at Blue Earth City, near the sources of the Blue Earth river.

In the western part of the state a considerable area of varying surface and deep-well high chlorine has been found, and its southern, and part of its southeastern, limits have been traced in Lac Que Parle, Yellow Medicine, Lyon, Redwood and Renville counties.

Excluding these high chlorine districts the state presents, thus far, a fairly constant percentage of chlorine, and in most of the

aforesaid districts the surface and subsoil waters correspond to the general state averages. The presence of small quantities of apparently normal nitrous acid have been noted over a limited area in Marshall and Yellow Medicine counties.

Low chlorine often occurs in evidently polluted rivers and creeks, but when considering their analytical data we must always expect a somewhat lower natural chlorine than that of the surrounding country springs, wells, etc., because of the large quantity of rain water which reaches rivers and creeks. In the majority of cases, however, sewage augments the chlorine until it equals or exceeds the country normal.

The samples examined represent every obtainable variety of water, selected with reference to probable purity. Dug wells and, where better could be obtained, bored wells, were usually excluded, as these two classes furnish a high percentage of polluted waters. The object was not to test the water of every well, but rather to obtain types of natural unpolluted waters over a large area of country, and with these to determine the normal chlorine.

The past season began with a thorough study of Olmstead county, which had already received some previous attention. (See 18th biennial report.) Working from the municipalities of Rochester, Chatfield and Byron as centers, 97 samples of water were taken in this county; they are represented by Nos. 924-1021, inclusive. One of the trips extended south, giving five samples in northern Fillmore county (Nos. 1007-1011, inclusive).

Excluding all waters of a doubtful purity, there were three samples which yielded .10, nine yielded .15, with others yielding .20 to .30 parts per 100,000.

Samples were taken in Goodhue county about Zumbrota, Red Wing, Kenyon and Cannon Falls, and in parts of Dakota, Dodge and Rice counties. The results are represented by Nos. 1022-1134 and 1155-80, making a total of 138 examinations.

Excluding the Red Wing series, the prevailing chlorine standard ranges from .10 to .30 per 100,000 parts, except in those examinations which were thrown out because of suspected contamination. The well at the Goodhue creamery gave a chlorine of 2.8 parts per 100,000, said to be from a depth of 208 feet. Comparison, however, with other deep wells points to contamination as probable in this case.

The non-flowing drilled wells, springs and creeks about Red Wing yielded no excess of normal chlorine over the above given

figures. There is, however, a large series of fine flowing wells in the city, and a few in the adjacent country, which yield chlorine similar to the Houston flowing wells. These wells are located on lower ground, and reach much deeper rock strata than the drilled wells in the country, as, for example, those represented by Nos. 1080-88. The Red Wing high chlorine wells are represented by Nos. 1056-57, 1060-66, 1093 and 1095-98. They range in depth from 200 to 675 feet, and yield from 3.0 to 32.0 parts of chlorine per 100,000 of water. Laboratory analyses were made of 10 of these wells. The free ammonias were all high, but showed a variation of .030 to .090. The albuminoid ammonias were low, ranging from .001 to .007. The highest ammonias and highest chlorines were given by the 525-foot Poor Farm well. The laboratory analyses will be found under Nos. 910-22.

Complete geological data were obtained for all high chlorine wells from Mr. Julius Gifford, the driller who put them down. In every instance the final datum is Potsdam sandstone, which is evidently the saltiferous stratum. As an example of the stratification, the following wells are given:

1.

RED WING SEWER PIPE CO.

Sandstone and gravel..	8 ft.
Hard pan..............	60 "
River sand............	52 "
Hard pan..............	30 "
Slate	125 "
Amsterdam sandstone..	270 "
Potsdam sandstone.....	30 "
	575 ft.

2.

GAS COMPANY.

Yellow Clay...........	8 ft.
Sandstone	95 "
Slate	100 "
Amsterdam sandstone..	190 "
Potsdam sandstone.....	25 "
	418 ft.

From Rice county, with Faribault and Northfield as centers, 92 samples were collected. These are represented by Nos. 1135-54 and 1181-1252. The normal chlorine continues here, also, to run from .10 to .30 per 100,000 parts, which figures are given by 63 out of the 92 samples.

Le Sueur county was studied from Le Sueur City and St. Peter as centers. The waters collected are represented by Nos. 1253-1320. Of these 78 samples, 45 yield .10 to .30 per 100,000 parts. In the city of Le Sueur high chlorine was shown in the city well,

a flowing artesian, 667 feet deep. The water yielding a chlorine of 2.5 parts, with an otherwise excellent analysis. (See F. A. No. 1257 and L. A. No. 866.) The stratification given by the engineer for this well was as follows:

Loam, clay and gravel	184 ft.
Granite (?)	25 "
Blue schist	5 "
White sandstone	453 "
	667 ft.

There are no other wells of this type in or near Le Sueur to compart it with. To the north, however, a deep well at Belle Plaine yields very high chlorine, and to the south a series of flowing wells in and about St. Peter yield even higher chlorine than the Le Sueur well. These are represented by Nos. 1284-86, 1316-18 and 1337. They are all fine flowing wells, yielding an otherwise excellent analysis.

There are two flowing wells in St. Peter, which are of the same reputed depth as the wells in the above mentioned series, that show a comparatively low chlorine. St. Peter city flowing artesian well yields still less. Its depth was given as about 200 feet. Presumably the wells represented by Nos. 1315-20 and 1338 are all shallower than those yielding the high chlorine.

The statements as to rock stratification were all general in character, and not very reliable. The deep wells at the State Hospital were said to go through drift, sandstone and limestone to 90 feet, then through red sandstone and white sandstone. The Colter well (1284) was said to pass through drift 90 feet, brown sandstone — feet, sandstone 10 feet, hard white rock 60 feet, sandstone 170 feet. For the Ottawa flowing artesian (1286) the following stratification was given:

1.		2.	
Drift	6 ft.	Red paint rock	10 in.
Sandstone	20 "	Trap rock	15-20 "
Limestone	8-10 "	Slate	4 ft.
Slate and soap stone	16 in.	Sandstone	"
Coal	1½ ft.		

The brewery well, 350 feet deep, which yields but .30 parts chlorine, receives most of its water from a depth of 200 feet or less. The well has the following stratification:

Drift		100 ft.
White sandstone	(flow)	100 "
Blue clay		60 "
Red sandstone		50 "
White sandstone		40 "

For No. 1320, the 365-foot rolling mill well, the strata given were sandstone and blue clay.

The eastern part of Nicollet county was studied from St. Peter as a centre; the southern part, from New Ulm and Sleepy Eye; the northern, from McGibbon and Gaylord. Samples from the last two named towns will be considered with Sibley county waters. The samples for Nicollet county taken from St. Peter are represented by Nos. 1321-37. A single well one-half mile north of St. Peter, towards Ottawa, exhibited high chlorine. This well is 393 feet deep, a flowing artesian coming through sand, sandstone and limestone, and corresponding in depth and analysis to the other deep flowing wells mentioned in the Le Sueur county series.

Another series of deep wells yielding high chlorine was found in New Ulm; their depth ranges from 200 to 300 feet, and their chlorine from 4.0 to 12.75 parts per 100,000. These wells are represented by Nos. 1428-31 and 1435. They all yielded fairly good analyses. Their free ammonias were high, but their albuminoid ammoinas and consumed oxygens were low, and there was an entire absence of nitrites. (See L. A. Nos. 877-80 and 882-3.)

These wells are all in the valley of the Minnesota. The city wells are drilled near the present river level, the others part way up the bluff. The differences in depth would closely agree with the surface elevations. There is an increase in chlorine, however, as one goes down the valley incline. All of the wells are on the south bank of the river, and possibly there is an incline here of a saltiferous stratum.

From the river surface down the strata run as follows:*

Loam	2 ft.
Yellow clay	18 "
Hard pan	1 "
Blue clay	150 "
Sandstone	29 " plus.

*Given by city water works engineer.

The Hauenstein brewery well, represented by No. 1431, is drilled to 293 feet. It is located on the side hill, considerably above the city, but its stratification is similar, as it passes through loam and clay and about 25 feet of sandstone at the bottom. For the other wells there was no definite data obtainable.

High chlorine was also shown by a series of seven springs and two shallow wells in New Ulm. The shallow wells were drilled 37 feet in the rock, at a point a short distance below the spring represented by No. 1432, and the deep well represented by No. 1431. The two wells were 100 feet or more apart, and on the same general level. The laboratory analysis of one of these shallow wells yielded results not in accordance with the deep well waters. This difference is seen most pronouncedly in the quantity of free ammonia, which was very much less in the shallow well sample (L. A. No. 923).

The seven springs exhibited a variety of analyses due inferentially to more or less surface contamination. They all show varying quantities of nitrates or nitrites, or both, which render it impossible to estimate the probable quantity of natural chlorine. Some of these springs were given further examination. (See L. A. Nos. 881 and 885.) The best analysis was given by the Hauenstein brewery spring (F. A. No. 1432, L. A. No. 881). It nevertheless showed considerable nitric acid, the evidence of oxidized organic matter. Taken by themselves, the whole series of springs would scarcely demonstrate a high chlorine district, but taken in conjunction with the deep and shallow wells they serve as corroborative evidence.

Several wells in the country around New Ulm were examined, and these gave conclusive evidence that the country wells do not reach the saltiferous stratum, as their general normal chlorine was from .10 to .30 parts per 100,000. (See analyses Nos. 1442-81 and 1924-32.)

In Sleepy Eye and the surrounding country the same general normal prevails. In a few deep wells, however, was found evidence of high chlorine. The well represented by No. 1391, and taken some 12½ miles southeast of Sleepy Eye, is drilled 180 feet; through yellow clay 18 feet, blue clay 152 feet, and sandstone to the bottom. Its partial analysis was good, although there was a remote possibility of infiltration from the barn, which is located some 60 feet distant. The well represented by No. 1393, about one-half mile from No. 1391, is also a deep drilled well, with a

good organic field analysis yielding 1.2 parts of chlorine. This is but .2 parts higher than its neighbor.

The series of Heimerdinger flowing wells represented by Nos. 1409-16, and taken about nine miles north of Sleepy Eye, are all within a mile of each other; they come out in a wooded ravine used as a pasture. Depths range from 225 to 250 feet, and that they are not all the same water is evident to the eye as shown by the presence of precipitated iron carbonate at the point of discharge of some, but not all, of them. These wells combine to form a considerable creek, represented by No. 1407.

For all but two the chlorine comes within the general country normal, but the wells represented by No. 1410 and 1413 show a considerably higher figure. They come up from about the same depth to about the same general valley level, and are situated about a quarter of a mile apart. The depth of all these wells was given in approximate figures, and consequently may be erroneous.

About a mile from the Heimerdinger series, another deep drilled well yielded a similar analysis. This is represented by No. 1424. It passes through 203 feet of sand and clay. No definite data as to stratification could be obtained.

The presence of high chlorine in a few wells scattered as these are cannot be taken as final evidence of normal high chlorine. There are too many possibilities of unseen pollution to form any ultimate opinion. They tend, however, to evidence the probable tapping of saltiferous strata. To the west of Sleepy Eye the general normal of .10 to .30 prevails, as evidenced by the samples taken in Springfield and vicinity. These are represented by Nos. 1483-1506. The only very deep well is in the village of Sanborn. It is drilled some 300 feet, and yields chlorine of .50. (See No. 1505 and L. A. No. 891.)

Still farther west chlorine is again in evidence in deep wells, as shown by samples from Revere, Walnut Grove, Lamberton and Vesta.

In the Lamberton series, represented by Nos. 1523-41, high chlorine is given by eleven deep drilled wells. These were taken over a considerable area of territory, and their data exhibit considerable variation, ranging from .80 to 7.9. The last figure is given by the city well. Despite its 180 feet of clay, this well is probably contaminated, as shown by the quantity of nitrites and nitrates. (See No. 1524 and L. A. No. 897.) It must, therefore, be excluded from consideration.

The environment of Nos. 1531 and 1532 should exclude them also from consideration until further analyses can be made. The high consumed oxygen of No. 1528 places it also in the doubtful list. The highest remaining well, yielding chlorine 4.3 parts per 100,000, is at the Wanda creamery (No. 1527). This well is drilled 188 feet through clay, hard pan and sandstone. There is no visible contamination, and the field analysis was fairly good.

The Revere series of samples, represented by Nos. 1507-1518, are all from flowing wells, ranging in depth 147 to 250 feet. They pass through loam, blue clay, yellow clay, gravel and into the sandstones. Their chlorines are all high and fairly constant, varying between 1.9 and 3.1 parts. Their organic analyses are in general good. No. 1514 represents a tank sample, and should be judged accordingly. Laboratory analyses were made of the new town well at Revere; also of Mr. Dahl's well. (See L. A. Nos. 892-3.) These showed excessive free but low albuminoid ammonias. This corresponds with the New Ulm analyses.

Southeast of Walnut Grove four wells drilled from 140 to 277 feet in loam, clay and sandstone were examined. They lie within a few miles of each other, and presented a chlorine ranging from 1.4 to 2.1 parts per 100,000.

In the village itself and in the country to the north six flowing and six non-flowing drilled wells were examined. These range in depth from 160 to 300 feet, and yielded a chlorine running from 2.0 to 8.7 parts per 100,000. Very little information as to geological data could be obtained, and most of the statements given would indicate simply the modified drift, excluding any rock strata.

Examinations were made last summer west of Walnut Grove and a high chlorine was found at Tracy and Marshall, in Lyon county. This year four deep wells west of Vesta, in Lyon county, were examined. They are represented by Nos. 1558-61. Very few desirable samples were available in this part of the country, as the water supplies consist chiefly of shallow wells, subject to outhouse and barn infiltration. The two fairly deep wells nearest to Vesta yielded a comparatively low chlorine. Presumably deeper wells in the country about Vesta would yield high chlorines, because such has been found north, south and west of this village.

Present information, based on all available wells, outlines the high chlorine district as bounded on the south and west by a line running from Lamberton west through Revere and Walnut Grove, then north and west through Marshall, Stavanger, St. Leo and

Salt Lake to Dakota, and on the east by a line running from Lamberton to Vesta, thence to Wood Lake. Beyond this point we cannot say.

East of this district the general chlorine normal of .10 to .30 per 100,000 parts prevails. This is shown in the 42 analyses of the Red Wood Falls waters. At this latter point, however, the deepest obtainable well was about 134 feet, through clay, quicksand and gravel. Its chlorine was .70, but its otherwise analysis was not above suspicion. The best wells were about 100 feet deep, and gave chlorine of .15 to .25.

Two miles east of Delhi the low chlorine of .05 parts was found in a single spring sample (No. 1565). This same standard had been occasionally met with in similarly isolated samples during previous years' work; also in some of the Glenwood springs.

Waters were examined in and near Morton, Franklin and Fairfax, in southern Renville county. The water samples taken in these towns and vicinity are represented by Nos. 1577-1632. Of these the majority of the passable waters yield a .10 to .30 chlorine. The high chlorine noticed in some of the analyses is in most instances easily accounted for by the presence of near-by pollution. A few wells, however, deserve special consideration. The deepest well sampled near Morton was the Ederer drilled well, 190 feet deep, and representd by No. 1591. The geological data was not obtainable. The field analysis showed a chlorine of 3.0, with an entire absence of nitrites and nitrates; oxygen consumed, .34. This last figure is rather high, and the additional fact that the barnyard is adjacent to the well would lead to a suspicion of surface infiltration.

Near Fairfax three reputed deep wells gave high chlorine data. These are represented by Nos. 1624-25 and 1631. The nitrous and nitric acid salts of the last two point to pollution, and a manure bank 25 feet from the well represented by No. 1624 probably accounts for its high chlorine. Too many of these reputed deep wells are supplied largely by surface and subsoil waters.

In Sibley county, southern McLeod and northeast Nicollet, 155 samples were taken, with Winthrop, Gaylord and Arlington and Belle Plaine as centers. These are represented by Nos. 1633-1788, and include 34 Winthrop surface and subsoil waters examined by request. A study of these analyses show the general .10 to .30 chlorine standard was found in a majority of the good waters.

There is probably a permissible variation up to .80, as exhibited in some of the deeper wells, which yielded a good field analysis. For example, the K. F. Whalen well, represented by No. 1664, is drilled through loam and yellow clay 90 feet, blue clay 65 feet, sand and gravel 145 feet, sandstone 36 feet, to the granite. It is highly improbable that pollution should reach this depth. There is, moreover, no trace of nitrites or nitrates: its chlorine of .80 may, therefore, be considered normal. The same may be said of the 300-foot Anderson well, represented by No. 1647, and yielding .50 chlorine, and of the 370-foot Myer well, yielding .60 (No. 1653).

The M. Fahey well, represented by No. 1780, gave a peculiar water, unlike any in its vicinity, or, for that matter, in the state so far studied. Its peculiarities consisted, first, in its producing a lather when shaken in a bottle, and, second, in its reaction to the general field tests. With brucine and sulphuric acid it yielded an olive green, and with potassium permanganate a similar color, apparently deoxydizing it with great rapidity. Furthermore, it yielded a chlorine of 2.3 parts per 100,000, which was not found elsewhere in the neighborhood, save in polluted waters. The given geological data were drift, soapstone and hard pan.

A considerable chlorine district was expected around Belle Plaine, but outside of the town well at 200 feet, and the known salt well at 700 feet, no very high natural chlorines were found. Indeed, the general .10 to .30 figure prevailed. The analysis of the town well itself shows that part of its chlorine comes from past pollution, as evidenced by the presence of nitrates. One strong proof, however, of the presence of considerable chlorine here is the marked increase in the data of the Minnesota river analyses. At Henderson there was .95 parts chlorine, which is already high, but at Belle Plaine there is 2.7, at Jordan to 3.5, and at Shakopee to 3.8 parts chlorine. This would point to a series of saltiferous springs feeding the river between Henderson and Shakopee. The amount of sewage in this river is comparatively small at these points, and not enough to account for any such change.

In Henderson there is a high chlorine well of excellent quality. It flows from a depth of 700 feet, through the following stratification:

1.

Loam and clay	20 ft.
Sand and gravel to	45 "
Gravel and limestone to	55 "
Kasota limestone to	164 "
Green clay and limestone to	320 "
White sand to.....(flow)	333 "
Red limestone to	450 "
Gray lime and sandstone to	480 "

2.

Red limestone to	490 ft.
White limestone to	525 "
White limestone to	580 "
Sandstone to	615 "
Green sandstone and limestone to	630 "
Mixed sandstone to	650 "
Fine sandstone to	690 "

Its heaviest flow is from the white sand at 333 feet. The chlorine was 1.1 parts per 100,000, and the organic analysis good.

Seven drilled wells, ranging in depth from 265 to 330 feet, were examined near the city, but they are all on higher ground than the above well, and yielded low chlorines (Nos. 1713, 1795, 1797 and 1799-1802). The saltiferous rock is evidently far below the surface.

Aside from the aforesaid exceptions the general chlorine of the available waters in western and northern Scott county is .10 to .30 parts, as shown by analyses of samples taken from Henderson, Belle Plaine, Jordan, Shakopee, Prior Lake and New Prague. These are represented by Nos. 1789-1882, and form the northeastern limits of the field work for the season of 1901.

The chlorine at Glenwood shows thus far a diminishing normal from .05 to .20 for Pope county. The samples, however, were largely from springs and wells within a few miles of Glenwood, and an examination of the deeper country wells may increase these figures. The analyses are shown under Nos. 1883-1924.

FIELD ANALYSES.

ANALYTICAL DATA IN PARTS PER 100,000.

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
924	Rochester, 2½ mi. N. E.	Geisinger's spring.......	......	.30	Strong	Absent	.18
925	"	Spring No. 2............	......	.30	"	"	....
926	" 3 mi. N. E....	Webber's farm spring..	......	.80	Trace	S. trace	.18
927	"	Geisinger's spring.......	......	1.2	"	Absent	....
928	" 3½ mi. N.. ..	J. Boller, drilled well...	60	.25	S. trace	S. trace	...
929	" 4 mi. N. E....	Richard's spring.........	......	.20	Marked	"	.12
930	" 8 mi. N. E....	Graham's spring........	......	.45	Trace	Absent	...
931	" 8½ mi. N. E.	Boeington's spring......	......	.20	Absent	"	....
932	" 8½ mi. N. E.	Pike's spring............	......	.30	Strong	Trace	....
933	"	Wm. McGovern's drilled well....................	287	1.5	Trace	Strong	.18
934	"	McGovern's spring......	......	.8	Strong	Absent	....
955	" 9 mi. N.......	E. Dodge, spring.........	......	.20	Trace	"	....
936	" 9½ mi. N.....	Roadside spring.........	......	.20	Absent	"	.10
937	" 8½ mi. N. E.	W. H. White, drilled....	323	.20	Trace	"	....
938	" 9 mi. N........	F. G. Harvey, spring....	......	1.5	"	"	....
939	" 10½ mi. N....	J. Doehring, drilled.....	250	.20	Absent	"	....
940	"	Cascade creek...........	......	.20	Strong	Trace	....
941	" ½ mi. E. of Chester....	Mrs. J. Hyslop, spring 1.	......	.50	Trace	Absent	....
942	"	" " 2.	......	.20	Absent	"	.11
943	"	T. L. Phelps, spring.....	......	.20	Trace	Distinct	....
944	"	Chester creek............	......	.20	"	Marked	....
945	" ½ mi. S. of Chester....	Ed. Berkins, spring.....	......	.20	"	Absent	....
946	" 2 mi. S. of Chester....	Pat Delany, drilled......	190	.20	Absent	"	....
947	" 2½ mi. S. of Chester....	C. Robinson, drilled......	130	2.0	Trace	"	....
948	" 3 mi. S. of Chester....	Marquette well..........	200	1.8	"	"	.22
949	"	Marquette spring........	......	1.0	"	"	....
950	"	A. Anderson, drilled....	179	1.7	"	S. trace	....
951	"	Andrews, driven........	65	2.3	Marked	Trace	.24
952	" at Marian....	Spring No. 1.............	......	.4	Trace	S. trace	....
953	" at Marian....	Marian spring 2.........	......	.30	"	"	....
954	" at Predmore.	Predmore's spring	......	.20	"	Trace	....
955	" 1½ mi. S. E. Predmore.	Roadside driven well....	......	.15	Absent	S. trace	....
956	" 4 mi. S. of Predmore.	Big spring...............	......	.20	"	Absent	....
957	" 4½ mi. S. of Predmore.	Landy's spring..........	......	.20	"	"	....
958	" 4½ mi. S. of Predmore.	Root river...............	......	.40	Strong	Trace	1.04
959	" 3 mi. S. E. of Pleasant Grove	Roadside spring.........	......	.15	Trace	Absent	....
960	" near Pleasant Grove.......	Pleasant Grove creek...	......	.20	Absent	"	....
961	" 12 mi. S.......	Root river...............	......	.25	"	"	.86
962	"	Insane asylum, dug well	35	.40	Strong	"	....
963	"	Insane asylum, artesian	......	.15	Absent	"	....
964	"	City Water Works, 11 wells, dug and driven..	......	.70	Strong	Trace	....
965	"	City tap..................	......	.70	V. Str'g	Absent	....
966	"	Bear Creek..............	......	.30	Strong	Distinct	.14
967	"	Zumbro river............	......	.40	"	Marked	.50
968	"	Cascade creek	......	.20	Trace	Absent	.38
969	Byron....................	Byron creamery, drilled	109	1.3	Absent	"	.24
970	" ⅓ mi. N...........	C. M. Allard, spring....	......	.40	Marked	"	....
971	" 3½ mi. N...........	Natural spring..........	......	.40	Absent	"	....
972	"	Branch of Zumbro river	......	.35	"	"	.42
973	" 5 mi. N............	Spring by road..........	......	.25	Marked	"	....
974	" 6 mi. N............	Ed. Searles, drilled......	165	.30	S. trace	"	....
975	" 6¼ mi. N..........	Sam Searles, drilled.....	124	.30	Marked	"	....

Abbreviations—S. trace-Small trace; V. str'g-Very strong; F. trace-Faint trace.

FIELD ANALYSES.—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
976	Byron, at Genoa	Genoa spring	....	.40	Marked	Absent	....
977	" 8 mi. N	H. Douglas, dug and drilled	130	1.1	"	"	....
978	" 2½ mi. S. Oronoco	B. Moulty, drilled	160	.20	"	"	....
979	" at Oronoco	Well at Lake Shady	50	.30	Absent	"	.12
980	" at Oronoco	Lake Shady	......	.15	"	"	....
981	" at Oronoco	Winthrow, drilled well	72	1.1	Strong	"	.18
982	" 3 mi. S. Oronoco	A. W. Clason, dug	......	.25	"	"	....
983	" 8½ mi. N. E. by E.	F. H. Huyles, drilled	145	.15	Marked	"	....
984	" 5 mi. E	Fred Mathias, drilled	140?	.20	Absent	"	....
985	" 2½ mi. E	R. Dean, drilled	140	.15	S. trace	"	.13
986	" 2 mi. E	Spring	......	.30	Absent	"	....
987	" 1½ mi. E	R. D. Maxfield, drilled	241	.15	"	"	.10
988	" ¾ mi. E	Grave yard spring	......	1.0	"	"	....
989	" 4 mi. S	D. Foast, spring	......	.25	Marked	"	.13
990	"	Ed. Michael, spring	......	.30	Strong	"	....
991	" 5½ mi. S	And. Seevert, drilled	100	1.0	"	"	....
992	" 3 mi. S	T. B. Isaacson, spring	......	.20	Marked	"	....
993	" 3 mi. S	M. Leqre, drilled	108	.15	S. trace	"	.29
994	" ½ mi. S	Mouldy, drilled	100	.45	Marked	"	....
995	" ¾ mi. S	A. McPeck, drilled	150	.7	"	"	....
996	"	Hotel well (Jones), dug	51	8.5	Strong	"	.34
997	Chatfield	Town well, drilled	200	.20	Marked	"	.15
998	"	Town tap	......	.15	Distinct	"	....
999	" 1 mi. E	M. Manahan, drilled	118	.25	"	S. trace	.10
1000	"	Jones, dug	......	7.0+	V. str'g	Absent	....
1001	"	Clayton hotel, dug	50	2.7	Strong	S. trace	....
1002	"	Root river, ice	......	.20	Absent	Absent	....
1003	" 1¼ mi. W	W. R. Means, spring	......	.30	Marked	"	....
1004	" 2 mi. W	J. Groby, drilled	77	.30	"	"	....
1005	" 2¼ mi. W	G. R. Widger	300	.30	Absent	"	....
1006	" 2¾ mi. W	John Groby, drilled	300	.20	"	"	....
1007	" 2 mi. S. W	W. F. Wolfgram, drilled	302	.20	S. trace	"	....
1008	" 2½ mi. S	L. J. Delany, drilled	136	.30	Distinct	"	....
1009	" 3½ mi. S	Roadside spring	......	.10	S. trace	"	.09
1010	" 8 mi. S	Large spring I	.....	.30	Trace	"	....
1011	" 8 mi. S	Large spring II	......	.10	"	"	....
1012	"	Otto Waller, drilled	85	.30	Distinct	"	....
1013	"	Laird, drilled well	374	.10	Trace	"	....
1014	" 3½ mi. N	Jno. Blakesely, drilled well	360	.15	"	"	....
1015	" 5½ mi. N	Wm. Bloetz, drilled well	95	.60	Strong	"	....
1016	" 5½ mi. N	Wm. Bloetz, spring	.....	.60	Marked	"	....
1017	" 5 mi. N	Booth's spring	.....	.30	"	"	....
1018	" 5 mi. N	Jno. McGuire, well bored	65	5.0	Strong	"	....
1019	" 3½ mi. N	Elick Mitchell, spring	.....	1.0	"	"	.22
1020	" 2 mi. N	Large spring	.....	.25	S. Trace	"	....
1021	" ½ mi. N	L. Jorgenson, spring	.....	.35	Marked	"	....
1022	Zumbrota	C. W. Scofield, drilled	219	.30	Absent	"	....
1023	" 4 mi. S	Mike Ludvig, spring	.....	.60	Marked	"	....
1024	Pine Island	Street well, dug	30	7.0+	Strong	S. Trace	.27
1025	"	Village well, dug and drilled	150	.30	Distinct	Distinct	.26
1026	"	Village tap	.....	.30	Marked	Absent	....
1027	"	C. R. Miller, drilled	60	.90	Strong	"	....
1028	"	C. R. Miller's spring	.....	1.2	"	"	.108
1029	Roscoe	Roscoe Creamery, drilled	30	6.0	"	"	.09
1030	E. Wanamingo	Alfred Steberg, drilled	60	.20	Marked	"	.14
1031	" "	Alfred Steberg, spring	.....	.40	Strong	Trace	....
1032	" "	Large spring	.....	.25	"	"	....
1033	" "	N. Branch of Zumbro river	.....	.45	Absent	Absent	....
1034	" "	Olstad's spring	.....	1.3	Distinct	Trace	....
1035	Zumbrota	Peter Hasgaphl, dug and drilled	65	.30	Trace	Absent	....
1036	" 3 mi. N. of Aspeland	Anfensen Lassesson's spring	.....	.40	Distinct	"	.14
1037	"	Roadside spring	.....	.80	"	Marked	....
1038	"	Town well, drilled	210	.15	Absent	Absent	.108

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1039	Zumbrota	Town tap	.....	.15	Absent	Absent	.102
1040	"	S. B. Barteau, drilled ?	80	6.1	Distinct	Distinct	.126
1041	"	Melted ice	.....	.15	Absent	Absent	.16
1042	"	H. Roisum, well	50	.45	Trace	Trace	....
1043	" 6 mi. E	J. J. Taft, drilled	216	.20	Marked	Absent	....
1044	Mazeppa, ½ mi. E	A. Woodworth, drilled	230	.25	"	"	....
1045	"	Hotel well, dug and drilled	70	.45	Distinct	"	....
1046	"	Zumbro River	.....	.25	"	Distinct	....
1047	" 6 mi. N. W.	Robt. Haas, drilled	170	.30	Marked	Absent	....
1048	Goodhue	Goodhue, old town well	183	.50	"	"	....
1049	"	Goodhue, new town well	200	.20	"	"	.09
1050	"	Goodhue Creamery	208	2.9	"	"	.14
1051	"	Wm. McHugh, drilled	243	.40	"	S. Trace	....
1052	Rice	Village pump, dug and driven	13	.40	Distinct	Absent	....
1053	Zumbrota	O. Hentz, drilled	180	.20	S. Trace	"	....
1054	"	Dr. Crewe, well	.....	3.4	Strong	"	.189
1055	Red Wing	R. W. Stoneware Co., flow. artesian	.....	.30	Absent	"	....
1056	" "	R. W. Brewery, flow. artesian	306	3.5	"	"	....
1057	" "	Sewer Pipe Co., flow. artesian	675	8.5	"	"	....
1058	" "	E. Erickson, flow. art.	.....	.50	F. Trace	F. Trace	....
1059	" "	Hay Creek	.....	.50	Trace	Trace	....
1060	" "	D. R. W. & S. R. R., flow. artesian	675	11.5	Absent	Absent	....
1061	" "	Minnesota Stoneware Co., flow. artesian	550	8.5	"	"	....
1062	" "	Mr. Danforth's flow. art.	585	17.5	"	"	....
1063	" "	Mr. Sargent's " "	500	17.5	"	"	....
1064	" "	D. Peterson " "	466	14.0	"	"	....
1065	" "	Poor farm " "	525	32.0	"	"	....
1066	" "	Spring Creek	......	1.10	Distinct	Marked	.80
1067	" " 6½ mi. N. W.	Purdy's spring No. 1	......	.15	Absent	Absent	....
1068	" " 7½ mi. N. W.	R. R. spring	......	.70	Strong	Trace	.22
1069	" " 7½ mi. N. W.	Burnside's spring	......	.50	Absent	"	....
1070	" " 7 mi. N. W.	7 mi. Creek	......	.20	"	"	....
1071	" " 8 mi. N. W.	Branch of Cannon River	......	.30	S. Trace	Marked	....
1072	" " 8½ mi. N. W.	Roadside spring	......	.30	Distinct	Trace	.20
1073	" " 8 mi. N. W.	Cannon River	......	.40	"	"	....
1074	" " 6 mi. W.	Swan Erickson dr'd well	115	.30	"	Absent	....
1075	" " 6½ mi. W.	C. Bryan's drilled well	......	.10	Trace	Trace	....
1076	" " 7 mi. W.	T. Bryan's drilled well	170	.10	"	Absent	....
1077	" " 8½ mi. S. E.	Roadside spring No. 2	......	.20	"	"	....
1078	" " 8½ mi. S. E.	Roadside spring No. 3	......	.20	"	"	....
1079	" " 9 mi. S. E.	Spring Creek head	......	.20	"	Trace	.72
1080	" " 10 mi. S. E.	Limberg's drilled well	......	.30	Absent	Absent	....
1081	" " 8 mi. S.	Anderson's drilled well	......	.30	"	"	....
1082	" " 9 mi. S.	N. Featherstone's drilled well	250	.20	"	"	....
1083	" " 10 mi. S.	H. Libby's drilled well	245	.20	"	"	....
1084	" " 10½ mi. S.	F. Featherstone's drilled well	247	.40	Trace	S. Trace	....
1085	" " 8 mi. S. W.	C. Featherstone's drilled well	200	.10	Absent	Absent	....
1086	" " 7¼ mi. S. W.	Will Perkins dril'd well.	240	.20	"	S. Trace	....
1087	" " 6½ mi. S. W.	E. Bennefeldt dril'd well	230	.50	Trace	Absent	....
1088	" " 6 mi. S. W.	M. Perkins drilled well.	230	.20	F. Trace	"	....
1089	" " 4 mi. S. W.	Porter's spring No. 1	......	.20	Trace	Strong	.16
1090	" " 4 mi. S. W.	Porter's spring No. 2	......	.30	"	Absent	.14
1091	" " 4 mi. S. W.	Porter's spring No. 3	......	.15	Absent	"	....
1092	" " 4 mi. S. W.	Trout Brook	......	.15	F. Trace	"	.56
1093	" "	J. Rich Sewer Pipe Co., flow. artesian	525	5.00	Absent	"	....
1094	" "	Remmler Brew. Co., dug and drilled	47	2.00	Strong	Trace	....
1095	" "	Gas House, flow. well	418	3.00	Absent	Absent	....
1096	" "	R. R. water tank, flow. well	200	11.00	"	"	....

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1097	Red Wing	La Grange Mills (mx. of 2 flow. wells)	360 396	4.00	Absent	Absent	....
1098	" "	State Training School	20	6.00	Strong	"	....
1099	" " 3 mi. S	Roadside spring, No. 4	......	.10	Distinct	"	....
1100	" " 6 mi. S. E.	Creek at Wacouta	......	.20	Trace	"	....
1101	" "	Luth. Ladies Seminary, drilled well	150	10.00	Distinct	"	....
1102	" " 5 mi. S. E.	J. Whitcomb's blasted well	......	2.8	"	Marked	.26
1103	Cannon Falls	Geo. Bramer, flow. well	400	.15	Absent	Absent	.135
1104	" "	Jno. J. Anderson, flow. well	416	.15	"	"	....
1105	" "	P. A. Peterson, drilled?	......	7.0+	V. Str'g	"	.216
1106	" " 2½ mi. S. W	Big Spring	......	.20	Distinct	"	....
1107	" " 2½ mi. S. W	E. A. Dibble, spring	......	.25	Marked	"	.117
1108	" " 2½ mi. S. W	E. A. Dibble, dril'd well	65	.30	Distinct	"	....
1109	" " 7 mi. S.	John Knutson, spring	......	.30	Strong	Absent	.135
1110	" " 3 mi. S. W	Little Cannon river	......	†			
1111	" " 8 mi. S.	And. Otternaw, drilled	40	.15	Distinct	Absent	....
1112	Wastedo	L. J. Johnson, dug	25	3.0	Marked	"	.108
1113	"	C. W. Bergren's dug and drilled	55	.30	"	"	....
1114	Cannon Falls, 8½ mi. S. E.	E. C. Larson, dug	75	.60	Distinct	"	....
1115	" 8. mi. S. E.	C. J. Anderson, dug and drilled	107	.30	S. trace	"	....
1116	" 7½ mi. S. E.	M. Swanson, dug and drilled	50	.75	Distinct	"	....
1117	" 7½ mi. S. E.	J. Miller, dug	22	2.9	Strong	"	....
1118	" 7½ mi. S. E.	S. M. Swanson, drilled	100	.25	Marked	"	....
1119	White Rock	Village well, dug and drilled	60	7.4	V str'ng	Strong	.225
1120	Cannon Falls	Hotel "Falls", drilled	100†?	1.3	Strong	S. trace	.185
1121	"	F. B. Segar, drilled	42?	1.2	"	Absent	.205
1122	"	Town well, drilled	206	.40	"	"	....
1123	"	J. L. Scofield, drilled	42	3.3	Marked	"	....
1124	"	Little Cannon river	......	.10	Trace	"	....
1125	"	Melted ice, Cannon Falls river	......	.15	S. trace	"	....
1126	" 3 mi. N. E.	F. A. Carnal, drilled	70	6.7	Strong	Strong	....
1127	" 3¾ mi. N.E.	M. D. Fling, drilled	......	.45	Marked	Absent	....
1128	" 5½ mi. N.	Jno. Heinlein, drilled	102	.40	Distinct	"	....
1129	" at New Trier	Village well, drilled	166	.40	"	"	....
1130	" at New Trier	T. O. Mamer, drilled	130	.70	Marked	"	.205
1131	" Hampton	R. Meis, drilled	122	.25	"	"	....
1132	" Hampton	Hampton stock yds. well	122	.15	"	"	....
1133	" 4 mi. N. W.	Geo. Valentine, drilled	50	7.5	Strong	S. trace	.225
1134	" 1 mi. N. W.	C. O. Bye, flowing	400	.20	Absent	Absent	....
1135	Northfield, 3½ mi. N.W.	W. H. Cody, dug	45	4.8	Strong	"	.26
1136	"	Chas. Wescott, drilled	79	.20	S. trace	"	....
1137	" 5½ mi. W.	Fred Alber, drilled	118	.10	"	"	....
1138	" 7½ mi. W.	Union lake	......	.10	"	"	.62
1139	" 7½ mi. W.	H. T. Johnson, drilled	110	.10	Trace	"	....
1140	" 9 mi. W.	J. K. Johnson, drilled	100	.10	S. trace	"	....
1141	" 12½ mi. W.	Tom Jerrick, drilled	124	.10	Distinct	"	....
1142	" 12 mi. W	Walter Shea, drilled	140	.10	S. trace	"	....
1143	" 13 mi. W	G. Thornby, drilled	168	.10	Absent	"	....
1144	" at Wheatl'd.	Jocob Schultz, dug	7	2.4	Strong	Strong	....
1145	" 16 mi. N. W.	Ed. Lambert, drilled	200	.30	S. trace	Absent	....
1146	" 16 mi. N. W.	Clem Perron, drilled	204	.10	Marked	"	....
1147	" 7 mi. S. E. Wheatl'd.	F. Coulterman, drilled	160	.20	S. trace	"	....
1148	" at Lester	C. V. Hirdler, dug	80	1.1	Distinct	"	.24
1149	" 10 mi. S. W.	Mrs. J. Dalby, drilled	142	.10	S. trace	S. trace	....
1150	"	Circle lake	......	.10	Absent	Absent	....
1151	" 10 mi. S. W.	Fox Lake	......	.10	"	"	....
1152	" 5 mi. S.	Wolf Creek Spring	......	.20	Marked	"	....
1153	" at Dundas	Dundas Spring	......	1.0	Strong	S. Trace	.84
1154	"	Cannon River	......	.10	Marked	Marked	....

† Sample bottle accidentally broken.

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1155	Kenyon, ¾ mi. S.........	H. C. Lubke, drilled....	74	.15	S. Trace	Absent	....
1156	" 2 mi. S..........	H. Rehnke, drilled.......	......	.10	Distinct	"	....
1157	" 3 mi. S. E.......	Martin Bakko, drilled...	110	.10	Marked	S. Trace	.16
1158	" at Skyberg......	Skyberg Cream'y, dril'd	85	.10	Absent	Absent	.10
1159	" 8 mi. S. E........	F. J. Nelson, drilled.....	55	.10	Trace	"	....
1160	" at Fairpoint	Branch of Zumbro R....	......	.10	S. Trace	"	....
1161	" at Fairpoint....	G. Gochmauer, spring..	......	.25	Marked	"	....
1162	" at Old Concord.	C. V. Calhoun, well.....	......	3.1	Strong	"	....
1163	" at Old Concord	Silver Creek............	.... .	.20	Distinct	S. Trace	....
1164	" at W. Concord.	Will Fulsum, flowing...	70	.10	Absent	Absent	....
1165	" " "	Public street well, dug.	......	11.0	V. Str'g	S. Trace	....
1166	" " "	Town well, drilled......	154	1.1	Distinct	Trace	.225
1167	" " "	A. D. Barr, drilled.......	86	.10	S. Trace	Absent	....
1168	" at Moland.......	Peter Hoffdahl, drilled..	132	.10	Distinct	Trace	....
1169	" 2 mi. N. Moland	K. O. Sahl, drilled.. ...	197	.10	Absent	Absent	....
1170	" 2 " "	Nels. Dyrdahl, drilled..	110	.15	Distinct	Trace	....
1171	" 2¼ " "	And. Lees, drilled.......	190	.10	Absent	"	.14
1172	" 3 " "	J. Martinson, drilled....	180	.10	S. Trace	"	....
1173	" 3 " "	J. F. Leonard, drilled...	100†	.10	"	Absent	....
1174	" 4 mi. W.........	Erick Gunhus, spring...	......	.45	Marked	Trace	....
1175	"	Town well, dug..........	20	3.5	V. Str'g	"	.14
1176	"	Geo. Lee, dug...........	30	7.8	"	S. Trace	....
1177	"	Mrs. E. Helton, dug.....	9	6.0	"	Trace	....
1178	"	Small spring............	......	13.5	Strong	Absent	.82
1179	"	Pearl Creek.............	......	3.0	V. Str'g	Marked	....
1180	"	Commercial Hotel, dug.	......	11.9	"	"	....
1181	Faribault................	Jno. Wagner, dug.......	30	4.0	Strong	Absent	....
1182	"	Dennison & Pierce, dug	......	2.4	V. Str'g	S. Trace	....
1183	"	Jno. Jepson, dug........	35	2.2	Strong	Absent	....
1184	"	Frank Morgan, dug......	30	1.5	"	"	....
1185	" 4½ mi. E.......	Henry Einberg, drilled.	100	1.9	"	Trace	....
1186	" 5½ mi. S. E....	W. K. Adams, drove....	20	1.7	Marked	Absent	.22
1187	" 5½ mi. S. E....	Spring..................	......	.30	Distinct	"	....
1188	" 6 mi. S. E......	Jno. O'Brein, drilled....	156	.30	Trace	Trace	....
1189	" 4 mi. S.........	Spring at Wolcott......	......	.30	"	Absent	....
1190	" at Wolcott.....	Straight River..........	......	.45	Absent	"	.62
1191	" 3 mi. S. W......	Dennison, drilled........	80	.80	"	"	....
1192	" 1½ mi. S.......	And. Thompson, well....	......	.45	Distinct	S. Trace	....
1193	" 2 mi. S.........	F. Berry, spring.........	......	.80	"	Absent	....
1194	" 3½ mi. S.......	Roadside well..........	......	.20	"	"	....
1195	"	Faribault, mix. city supply, 2 dri'd, 2 dug wells	......	.30	Trace	"	.15
1196	"	1st city shallow..........	20	.20	Distinct	"	.14
1197	"	2nd city shallow.........	20	.25	"	"	.12
1198	"	Herman Pofahl, drove..	15	1.0	Marked	"	....
1199	"	Robert Pofahl, drove....	15	1.0	Strong	S. Trace	....
1200	"	L. Gebhart, driven......	15	1.9	"	Distinct	....
1201	"	Melted ice...............	......	.10	Absent	Absent	.13
1202	"	Faribault, tank..........	......	.30	Trace	S. Trace	.18
1203	Northfield................	Northfield, city well, flowing................	647	.10	S. Trace	Absent	.08
1204	"	F. A. Noble, driven.....	20	.25	Absent	"	.09
1205	"	Cannon River...........	......	.20	Marked	Marked	....
1206	"	Theo. Miller, flowing....	59	.10	Distinct	Absent	....
1207	"	Theo. Miller, II flowing.	71	.10	S. Trace	"	....
1208	"	Henderson, drilled......	70	1.4	Strong	S. Trace	.12
1209	"	Jno. Ways, drilled.......	65	.10	Absent	Absent	.04
1210	"	S. Raneri, drilled........	40	.70	Distinct	"	....
1211	"	F. A. Cone, drilled......	......	2.5	Marked	S. Trace	....
1212	" 1½ mi. E......	White Creek............	......	.10	Distinct	Absent	....
1213	" 2 mi. E........	I. N. Festler, drilled....	125	.20	"	"	....
1214	" 3 mi. E........	E. S. Lyman, driven....	87	.15	Absent	"	....
1215	" 3½ mi. E......	J. J. Henderson, drilled	122	.10	S. Trace	"	....
1216	" 4 mi. E........	Birans, well............	......	.45	Marked	"	....
1217	" 4½ mi. S. E....	Prairie Creek...........	......	.10	"	"	....
1218	" 2½ W. of Dennison.........	Roadside well..........	......	.35	"	"	....
1219	" 3½ S. W. of Dennison	Jno. Martin, drilled.....	100†	.95	Strong	"	.32
1220	" 4 mi. S. W. of Dennison.....	I. Ingleset, well...... ..	40	5.0+	"	"	....

† Approximately.

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1221	Northfield, 7½ mi. S. E..	J. T. Nelson, drilled.....	95	.10	S. Trace	Absent.	....
1222	" 7 mi. S. E......	F. Koester, dug, drilled.	160	.10	Trace	"	....
1223	"	Sherwood, dug..........	......	.60	Strong	"	....
1224	"	Jim Minor..............	......	.30	"	"	....
1225	"	Stockyards, flowing.....	70	.10	Absent	"	.09
1226	"	H. Greaves, wel	......	.35	Strong	Trace	....
1227	"	Melted Ice..............	......	.10	Absent	Absent	....
1228	Faribault................	Cannon Lake............	......	.15	"	"	.44
1229	" 4½ mi. W.....	Roadside well...........	......	1.5	"	"	....
1230	" 8 mi. W.......	Cedar Lake..............	......	.15	S. Trace	"	....
1231	" 10 mi. W......	J. Wenger, drilled.......	125	.15	Absent	"	....
1232	" 10½ mi. W....	W. Dusbartker, drilled.	140	.20	Trace	"	....
1233	" 10½ mi. W....	F. Dusbartker, spring...	......	.15	Marked	Marked	....
1234	" 11 mi. W.....	Mud Lake...............	......	.15	Absent	Absent	....
1235	" 12 "	Nelson spring............	......	.15	Trace	Trace	....
1236	" 12 "	" " 2..........	......	.15	"	"	....
1237	" 14 "	A. Krolman..............	220	.15	S. Trace	Absent	....
1238	" 12 mi. W. by N..	McFaddens	260	.20	Absent	"	....
1239	" 10 mi. N. W.....	Mr. Nagle................	297	.25	"	"	.14
1240	" 9 "	Hunt's Lake.............	......	.15	"	"	....
1241	" 11 "	Tifft's Lake..............	......	.15	"	"	....
1242	" at Shieldsville..	Lake Mazaska...........	.....	.15	"	"	....
1243	"	Flaherty's spring........	......	1.5	Strong	"	....
1244	" 8 mi. N. W.....	O. Ellingson, drilled.....	110	.20	Absent	"	....
1245	" 8 "	Fox Lake................	......	.15	S. Trace	"	....
1246	" 6 "	Roberts Lake............	......	.15	Absent	"	.26
1247	" 5 mi. N.........	Smidz's drove well......	40	.70	Distinct	"	....
1248	" 4½ "	Manahan, dug well......	70	.15	S. Trace	"	....
1249	" 3½ "	Pleasants well, dug......	25	1.40	Strong	Trace	....
1250	" 3 "	Friezem, drilled.........	95	.20	S. Trace	Absen	....
1251	" 2½ "	Weires, drilled...........	81	.20	"	"	....
1252	"	Cannon River............	......	.20	Trace	"	....
1253	Le Sueur.................	Dr. LeClerc, drilled.....	120	.10	Marked	Marked	....
1254	"	Mrs. S. A. Dane, spring..	......	3.6	Strong	S. Trace	.17
1255	"	Minn. River, below sewer	......	.40	Distinct	Trace	....
1256	"	Minn. River, above sewer	......	.25	"	S. Trace	....
1257	"	LeSueur City, flow'g well	667	2.5	Absent	Absent	.20
1258	"	LeSueur City, tap........	......	2.5	Distinct	"	.28
1259	"	E. Phillips, drilled.......	175	.30	Marked	Distinct	....
1260	" 2 mi. S. E.......	S. A. Dane, drilled.......	158	.20	Absent	Absent	....
1261	" 3 "	J. Moulten, spring.......	......	.30	Strong	"	....
1262	" 3 "	LeSueur Creek...........	......	.20	Marked	Distinct	....
1263	" 3 "	Spring in pasture........	......	.15	Absent	Absent	....
1264	" 6 "	S. N. Arbuckle, drilled..	180	.15	"	"	.10
1265	" 7 "	Aug. Ziebart, drilled....	250	.15	"	"	....
1266	" 7 "	Aug. Fust, drilled.......	225	.15	"	"	....
1267	" at LeSueur Center	Town well, drilled.......	240	.15	"	"	....
1268	" " " "	Jail well, dug...........	46	8.0+	Strong	"	....
1269	" " " "	Court House, drilled....	212	.25	Absent	"	....
1270	" " Lexington...	Clear Lake, a spring in the lake................	......	.15	"	"	.14
1271	" " " ...	Clear Lake, center	......	.20	S. Trace	S. Trace	.26
1272	" " St. Thomas..	G. Conley, dug..........	......	2.0+	Marked	Trace	....
1273	" " " ..	B. J. Coleman, dug......	26	2.0+	Strong	"	....
1274	" 7 mi. N. E... ...	G. W. Burns, dug........	......	2.0+	"	"	....
1275	" 4 mi. E.........	Frank Dime, dug........	30	1.3	"	Strong	....
1276	"	Rheinert, drilled.	100	.15	Absent	Absent	....
1277	"	Dr. LeClerc, drilled.....	120	.20	Trace	"	....
1278	"	LeSueur, Melted Ice, Minn. River...........	......	.10	"	Trace	....
1279	St. Peter, 1½ mi. N.....	Marley's spring..........	......	.15	Absent	Absent.	....
1280	" 2½ "	C. D. Droutell, spring....	......	.30	Trace	"	....
1281	" 3 "	Seven Mile Creek........	......	.15	Absent	"	....
1282	" 3¾ "	Steinke spring...........	......	.60	Trace	"	....
1283	" 4½ "	C. Cinders, spring.......	......	.15	Absent	"	....
1284	" 5 "	Jno. Coulter, flowing....	330	16.00	"	"	.10
1285	" at Ottawa......	Wm. Swartz, flowing....	410	16.00	"	"	.10
1286	" " "	Ottawa flowing well.....	457	10.00	"	"	.10
1287	" " " 1 mi. S. W.	Jim Hayes' spring, 1....	......	.50	Trace	"	....

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1288	St. Peter, at Ottawa, 1 mi. S.W.	Dacody Lake	......	.15	Absent	Absent	....
1289	“	Hayes' spring, 2	......	.50	Trace	“	....
1290	“ 4 mi. N. E.	Rudke's spring	......	.50	“	“	....
1291	“ 4 “	Oelrichs Creek	......	.25	“	“	....
1292	“ 3½ “	H. Schultz, No. 1 spring.	......	.20	“	“	....
1293	“ 3½ “	“ “ 2 “	......	.20	Absent	“	.12
1294	“ 3½ “	“ “ 3 “	......	.20	“	“	....
1295	“ 3½ “	Slinners, dug	......	.80	Distinct	“	.64
1295 A	“ 3 mi. N	Charles Carpenter, drilled	260	.25	Trace	“	....
1296	“ 5½ mi. E	H. Corn, drilled	225	.20	Absent	“	....
1297	“ 6½ “	Martin Stengel, drilled.	270	.20	“	“	.14
1298	“ 7 “	Joe Shep, drilled	213	.25	“	“	....
1299	“ 8 “	L. Puffpaff, drilled	170	.20	“	“	.12
1300	“ 8 “	L. Puffpaff, spring	......	.20	“	“	.10
1301	“ 8 “	Lake Henry	......	.20	“	“	.86
1302	“ 7½ mi. S. E	Lake Jefferson	......	.20	“	“	....
1303	“ “ “	F. W. Wendleschafer, bored	25	1.25	Trace	Trace	.42
1304	“ “ “	Little Fred Wendleschafer, drilled	175	.20	“	“	.14
1305	“ 8 “	Thomas Mulvahn, drilled	150	.15	Absent	Absent	....
1306	“ 7 “	Lake Washington	......	.20	“	“	....
1307	“ 6½ “	Kendall, drilled	152	.20	“	“	.12
1308	“ 4 mi. E	Roadside, drilled	......	.20	“	“	.14
1309	“ 3 “	Roadside, dug	......	2.00	Strong	Trace	.36
1310	“ 2½ “	Lake Emely	......	.25	Absent	Absent	.68
1311	“ “ “	F. L. Volk, drilled	172	.30	S. Trace	S. Trace	....
1312	“ “ “	C. E. French, drilled	257½	.15	Absent	Absent	.12
1313	“ 1 mi. E	Spring at Spring Lake.	......	.50	Trace	“	....
1314	“	Spring Lake	......	.25	Distinct	“	.56
1315	“	Brewery well, flowing.	350?	.30	Absent	“	....
1316	“	S. Insane Asy'm, 1, flow.	130	5.30	“	“	.10
1317	“	“ “ 2, “	350	6.25	“	“	.10
1318	“	“ “ 3, “	300	13.00	“	“	.12
1319	“	Minnesota River ice	......	.10	Trace	Distinct	.624
1320	“	St. Peter Rol'g Mill, flow.	365	.35	Absent	Absent	....
1321	“ 1 mi. N	Omaha spring	......	.35	Distinct	“	....
1322	“ 2 mi. W	Sandeen, drilled	270	.15	Absent	“	....
1323	“ 2½ “	And. Leveen, drilled	230	.20	“	“	....
1324	“ 5 “	Thomas Burch, drilled.	272	.30	“	“	....
1325	“ 7 “	Creek	......	.15	“	“	....
1326	“ at Lange	Creamery, drilled	340	.15	“	S. Trace	....
1327	“ 8 mi. W.	F. E. Boys, drilled	365	.20	“	Absent	....
1328	“ at Oshawa	H. Frick. “	160	.15	“	“	....
1329	“ at Nicollet	G. H. Berger, drilled	180	.15	“	“	....
1330	“ “ “	Village well, “	165	.15	“	“	....
1331	“ “ “	Matt Burg, “	......	.60	S. Trace	“	....
1332	“ “ “ 2 mi. N.	Swan Lake	......	.95	“	“	....
1333	“ Norseland, 4 mi. S.	Jno. Burg, drilled	180	.20	Distinct	Trace	....
1334	“ 8 mi. W	H. C. Hanson, drilled	120	.30	S. Trace	Absent	....
1335	“ 5½ mi. W.	Frank Wolff, drilled	188	.20	“	Marked	....
1336	“ at Traverse	Village well, dug	......	6.0+	V. Str'g	Strong	....
1337	“ 1½ mi. N	T. Claus, flowing	393	16.0	Absent	Absent	.10
1338	“	City artesian	200†	.20	“	“	.16
1339	“	City tap	......	.20	“	“	.24
1340	Redwood F'ls, 3 mi. W.	Whitte's well	......	.30	Marked	“	....
1341	“ “ 5½ mi. S.W.	H. F. Jackson, driven	60	2.5	“	“	....
1342	“ “ 9 mi. S. W.	A. E. Clark, spring	......	.15	Trace	“	....
1343	“ “ 9 “ “	Redwood Riv. at Clark's	......	.50	Absent	Trace	....
1344	“ “ 12 “ “	H. Davis, spring	......	.15	“	Absent	....
1345	“ “ 12 “ “	Redwood River	......	.60	S. Trace	Strong	....
1346	“ “ 15 “ “	Matt Martin, dug	40	.20	Strong	Absent	....
1347	“ “ at Wabasso	Hotel at Wabasso, bored	40	1.90	V. Str'g	“	....
1348	“ “ 15 mi. S. W.	R. J. McCormick, “	34	.15	....	Strong	....
1349	“ “ 12 “ “	W. D. Smith, “	60	.25	S. Trace	Absent	....
1350	“ “ 1½ mi. “	H. Werner, “	40	.80	“	“	....
1351	“ “ 5½ “ “	S. P. Marvin, “	69	3.30	V. Str'g	“	....
1352	“ “ 5 mi. E.	Redwood Sp'g, No. 1	......	.15	Trace	“	.12

† Approximately.

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1353	Redwood Fl's, 5½ E....	Redwood Sp'g, No. 2....	......	.15	Trace	Absent	....
1354	" " 5¾ E......	" " " 3....	......	.15	"	"	.10
1355	" " 6 mi. E....	" " " 4....	......	.15	"	"	....
1356	" " 6⅛ mi. E...	" " " 5....	......	.40	"	Trace	.16
1357	" " 6½ " ...	" " " 6....	......	.15	"	Absent	....
1358	" " 6¾ " ...	Jones' spring..........	......	.20	Marked	"	....
1359	" " 9 " ...	Knipple's spring........	......	.15	S. Trace	"	....
1360	" " 10 " ...	Newton's "	......	.40	Marked	"	....
1361	" " 10⅛ " ...	Sieber's " No. 1...	......	.15	Absent	"	....
1362	" " 10⅛ " ...	" " " 2..	......	.15	"	"	....
1363	" " 10⅛ " ...	" " " 3..	......	.15	....	"	....
1364	" " 10½ " ...	Briar's spring..........	......	1.00	V. Str'g	S. Trace	....
1365	" " 12 " ...	Post's "	......	.15	Absent	Absent	....
1366	" " 7 miles N. Morton..	Wabasso Creek..........	......	.15	Trace	S. Trace	....
1367	" " at Morgan.	Morgan, town well......	116	1.10	V. Str'g	Absent	.30
1368	" " "	C. Green's mill well.....	116	.15	Absent	"	.14
1369	" "	Jacob Giem......	134	.70	S. Trace	Trace	.16
1370	" "	Davison's, No. 1, dug....	45	3.5	V. Str'g	"	....
1371	" "	" " 2, "	90	.15	Absent	Absent .	....
1372	" " 2 mi. S. W. Davison's..	E. Paulson's, drilled.....	130	.25	S. Trace	"	....
1373	" " at Gilfillan	C. D. Gilfillan's, bored..	84	1.20	Marked	Trace	.15
1374	" "	Dumistrons..............	......	2.50	"	Strong	....
1375	" " ½ mi. S....	A. D. Smith's, bored....	90	.15	Absent	Absent	....
1376	" "	City spring, No. 1.......	......	.30	"	"	.19
1377	" "	" " " 2.......	......	.30	"	"	.13
1378	" "	" " " 3.......	......	.15	"	"	.13
1379	" "	City mixed supply.......	......	.25	"	"	.14
1380	" "	City tap................	......	.25	Marked	Trace	.13
1381	" "	Redwood River..........	......	.50	"	"	.63
1382	Sleepy Eye, 4 mi. S......	Cottonwood River......	......	.15	Absent	Absent	....
1383	" " 4 "	Sp'g No. 1 on Cot'w'd R.	......	.20	"	"	....
1384	" " 4 "	" 2 " " .	......	.25	S. Trace	"	....
1385	" " 6½ "	W. D. Carpenter's, dril'd	154	.20	Distinct	"	....
1386	" " 12 mi. S. W.	Jno. Alternault's drilled well.............	207	.15	Absent	"	....
1387	" " 12 mi. S.....	Creek (Lit. Cot'nw'd R.)	......	.15	S. Trace	"	....
1388	" " 8½ "	Geo. Eckstein's, dug and bored..................	90	.55	"	"	....
1389	" " 9 mi. S. E...	Albin Creamery, drilled	90	.15	Absent	Trace	....
1390	" " 12 " ...	J. Rossback's, dug.......	40	.20	Distinct	Absent	....
1391	" " 12½ mi. S...	A. L. Rice's, drilled.....	180	1.4	Trace	"	.12
1392	" " 12½ "	Lake Hanska............	......	.50	Absent.	"	....
1393	" " 11 mi. S. E..	Wm. Rossback, drilled..	290	1.2	S. trace.	"	.10
1394	" " 7 mi. S......	O. Minor, " ..	255	.35	Absent.	"	....
1395	" " 4½ mi. S. E.	C. Stuebe, " ..	275	.35	"	"	....
1396	" " 3 mi. S. E...	James Dineen, spring...	......	1.3	Strong..	Trace ..	....
1397	" " ½ mi. E. ...	Romberg, drilled........	154	.30	Absent.	Absent.	....
1398	" "	Town well, bored........	98	1.0	Strong..	S. trace	....
1399	" "	Town tap...............	......	1.0	"	Trace ..	....
1400	" "	School well.............	198	....	....	....	....
1401	" "	Gersehwind, dug........	70	1.5	Strong..	Marked	....
1402	" "	Sleepy Eye Bottling Co., well....................	26	9.0+	V. str'g.	"	....
1403	" "	A. Steffen, brew'y, well	155	.15	S. trace	Absent.	....
1404	" " 5½ mi. N. E.	Home Creamery, well...	130	.20	Absent.	"	....
1405	" " 6 mi. N.....	G. Cutting, tubular.....	110	.10	"	"	....
1406	" " 9 "	Rafferty's, bored........	86	.30	"	"	....
1407	" " 9½ "	Heimerdinger, creek....	....	.15	"	"	....
1408	" " 10 "	J. Cleary, spring........	......	.15	"	"	....
1409	" " 9 "	Heimerdinger, flowing, No. 1.	225†	.20	"	"	....
1410	" " 9 "	" " " 2.	250†	2.4	"	"	.13
1411	" " 9 "	" " " 3.	225†	.10	S. trace.	"	.12
1412	" " 9 "	" " " 4.	225†	.15	Trace. .	"	....
1413	" " 9 "	" " " 5.	250†	1.2	Absent.	"	.13
1414	" " 9 "	" " " 6.	225†	.15	S. trace.	"	....
1415	" " 9 "	" " " 7.	225†	.10	Absent.	"	....
1416	" " 9 "	" " " 8.	225†	.10	"	"	....
1417	" " at Ft. Ridg'y	C. Cumming's, spring...	......	.15	Trace ..	"	....
1418	" " " "	Minnesota River........	......	.		"	....

† Approximately.

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1419	Sleepy Eye, at Ft. Ri'gly	Ft. Ridgely creek	......	5.5	Marked	Absent	.62
1420	" " at Ft. Ridgely, ½ mi. E	Big Spring...............	......	.90	Distinct	"	....
1421	" " at Ft. Ridgely, 1 mi. E..	Nelson's spring..........	.... .	.50	Distinct	"	....
1422	" " at Ft. Ridgely, 2½ mi. E.	O'Shea Spring...........	......	.10	Trace ..	Marked	....
1423	" " at Ft. Ridg'y	Henderman's well......	22	6.0	V. st'ng	Trace ..	....
1424	" " 8 mi. N. E..	Wm. Raverty's well.....	203	2.9	Absent.	Absent.	.12
1425	" " 9 "	Werring spring, 1.......	......	.35	"	"	....
1426	" " 9 "	Werring spring, 2.......	......	1.3	"	"	....
1427	" " 9 "	Werring creek	......	3.1	Marked	Distinct	....
1428	New Ulm................	City well, No. 1.........	200	11.5	Absent.	Trace ..	....
1429	" "	City well, No. 2	200	12.75	"	" ...	....
1430	" "	City well No. 3..........	200	11.5	"	" ...	....
1431	" "	J. Hanenstein's br'y, dr'd	293	8.0	"	Absent.	....
1432	" "	J. Hanenstein's spring..	......	1.1	Strong..	"	....
1433	" "	Hanenstein, spring, 2...	......	.70	"	S. Trace	....
1434	" "	C. Hanenstein, dri'd well	37	1.2	Absent	Absent	....
1435	" "	A. Schell, brewery......	285	4.0	"	"	....
1436	" "	A. Schell, spring... ..	......	3.0	Strong	Distinct	....
1437	" "	Goosetown. spring......	......	.90	V. Str'g	Absent	....
1438	" "	Empire, spring..........	......	5.5	Strong	S. Trace	...
1439	" "	Steam Laundry, spring.	......	10.2	V. Str'g	Marked	....
1440	" "	Shoe Factory, spring....	......	5.0	Strong	Absent	....
41	" "	City tap................	......	13.3	Marked	Marked	....
1442	" " 2 mi. S........	Big Cottonwood River..	......	.45	Absent	Absent	.50
1443	" " 2 "	Roadside spring.........	......	.40	Marked	Trace	....
1444	" " 5 "	H. Schiebel, drilled.....	200	.10	Absent	Absent	....
1445	" " 5½ "	And. Carpenter, drilled	220	.10	"	"	....
1446	" " 6 "	Little Cottonwood......	......	.10	"	Trace	....
1447	" " 6½ "	Alb. Zick, drilled........	214	.10	S. Trace	Absent	....
1448	" " 2 mi. S. E.....	Aug. Petener, drilled...	150†	.40	Absent	"	....
1449	" " 10 "	A. C. Astrip, drilled	230	.25	Marked	Distinct	....
1450	" " 9 "	R. Hughs, drilled.......	100†	.25	Absent	Absent	....
1451	" " 9½ "	J. D. Price, drilled......	134	.30	"	"	....
1452	" " 9 "	E. V. Price, spring 1.....	......	.10	Distinct	"	....
1453	" " 9 "	" " 2....	......	.20	Trace	Distinct	....
1454	" " 9 "	" " 3....	......	.30	S. Trace	Absent	....
1455	" " 6 mi. E........	Mr. Davis, well..........	230	.20	Absent	"	....
1456	" " 7 mi. S. E.....	Jno. Siebert, drilled....	159	.25	"	"	....
1457	" " 4 "	Joe Schraeffer, drilled..	119	.10	"	"	.38
1458	" " 3½ "	St. Louis R. R , sp'g No. 1	......	.35	"	"	....
1459	" " 3½ "	" " " 2	......	.10	"	"	....
1460	" "	New Ulm, ice from Minnesota River...........	......	.15	Trace	"	....
1461	" " 3½ mi. N. W..	H. Zimmerman, bored..	158	.20	S. Trace	"	....
1462	" " 7 mi. E........	Alb. Busebus, drilled...	163	.15	"	"	....
1463	" " 7½ mi. N. E...	Germ'n L. Cong. church, bored..................	160	.25	Absent	"	....
1464	" " 8½ " ...	H. Kemmer, well........	......	.15	"	"	....
1465	" " 9 mi. E	F. Brems, drilled........	120	.50	"	S. Trace	....
1466	" "	Carl Richaert, drilled...	260	.40	Distinct	Trace	....
1467	" " 1 mi. E. Courtland.........	H. Poeler, drilled.......	105	.10	Absent	Absent	....
1468	" " at Courtland..	Shallow street well......	......	5.0+	Strong	S. Trace	....
1469	" " " "	Mr. Summers, dug......	25	.45	Marked	Absent	....
1470	" " " "	Stege's pasture well....	......	.25	Distinct	"	....
1471	" "	H. Bode, drilled.........	120	.50	"	"	....
1472	" " 2 mi. E. Courtland	Elra Doty, drilled.......	140	.25	Trace	"	....
1473	" " 2 mi. E. Courtland.........	D. Seemanns, drilled....	140	.15	Absent	"	....
1474	" " 2½ miles N. E. Courtland...	T. Lang, "	160	.15	"	"	....
1475	" " 3 mi. N. Courtland.........	Jack Irvin, "	160	.10	"	"	....
1476	" " 3 mi. N. Courtland.....	Nick Anding, "	180	.20	Marked	"	....
1477	" " 8 mi. E........	Wm. Bendix, "	118	.15	Absent	"	....
1478	" " 7 "	H. Harmony, "	160	.20	"	"	....

† Approximately.

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1479	New Ulm, 8 mi. N. E....	Jacobsons, drilled.......	260	.10	Absent.	Absent.	....
1480	“ “ 2½ mi. N......	Randeutch, “	197	.25	“	“	....
1481	“ “	Minnesota River.........	......	.40	S. Trace	Trace	....
1482	“ “	F. Frenzel Bottling Co., spring	......	5.9	Strong	S. Trace	.10
1483	Springfield 1 mi. S. W...	J. Schneider, drilled well	75	.15	Absent	Absent	....
1484	“ 7½ mi. S. W.	J. Calahan, spring.......	......	.10	“	“	....
1485	“ 10 mi. S. W..	Mr. Jaska, drilled well..	......	.25	Strong	Distinct	.17
1486	“ 10½ mi. S. W	D. Beck, drilled well.....	......	.18	“	Absent	....
1487	“ 10½ mi. S....	L. Parsons, drilled well.	100†	.25	“	“	....
1488	“ 12½ mi. S. W.	Large spring on Cottonwood River	......	.20	Marked	S. trace	....
1489	“ 12½ mi. S. W.	Little Cottonwood River	......	.20	Distinct	Distinct	....
1490	“ 14 mi. S. W..	Mr. Brutkietz, drilled well	146	.12	Marked	S. trace	....
1491	“ 13½ mi. S ...	Jno. Kelly, dug well..	50	.35	Trace	Distinct	....
1492	“ 11 mi. S. E...	Liesenfeldt, flowing well	60	.15	S. trace	Absent	....
1493	“ 11½ mi. S. E.	Suttler's spring.........	......	.15	Marked	“	....
1494	“ 12 mi. S. E...	Geo. Herring, flow well.	75	.10	S. trace	“	....
1495	“	Big Cottonwood River...	......	.30	“	“	.16
1496	“	City well, flowing.......	33	.10	Trace	Marked	.17
1497	“	Bottling Co., flowing well	21	.10	Absent	Absent	.15
1498	“	Melted ice, Cottonwood River	......	.10	“	“	.10
1499	“ 5 mi. N. W...	Aug. Schultz, bored well	95	.40	S. trace	“	....
1500	“ 6½ mi. N. W.	Wm. Stenz, dug and drilled well	140	.40	Distinct	S. trace	....
1501	“ 6½ mi. N.....	G. Janke, spring.........	.....	.35	S. trace	“	....
1502	“ 7 mi. N. E...	Joe Nagel, bored well...	100	.10	Absent	Absent	....
1503	“	Mr. Bophy, drilled well	115	.20	S. trace	“	....
1504	“	C.V. Lamb, drilled well.	110	.55	“	“	....
1505	Sanborn..................	Village well, drilled.....	300	.50	Distinct	“	.10
1506	“	Dr. Bennett's. bored well	32	1.00	Strong	Distinct	.10
1507	Revere	Old town well, flowing..	190	1.9	Absent	S. trace	.078
1508	“	New town well, flowing.	250	1.9	“	Absent	.066
1509	“	H. H. Dahl, flowing well	185	2.0	“	Distinct	.099
1510	“ 2½ mi. N. W.....	F. Kreuger, flowing well	......	3.1	“	Absent	.066
1511	“ 1½ mi. N. W.....	C. O. Nicols, flowing well	150	2.5	“	S. trace	.055
1512	“ 1 mi. W	J. Benedict, flowing well	154	1.9	“	Absent	....
1513	“ 3 mi. S. W........	W. W. Seaver, flowing well	154	1.9	“	“	....
1514	“ 4 mi. S. W........	‡Ed. Randolph, flowing well	......	2.0	Distinct	Trace	....
1515	“ 4½ mi. W.........	Joe Wiggins, flowing well	176	2.0	Absent	Absent	....
1516	“ 4 mi. W...........	L. Wiggins, flowing well.	150	1.95	“	“	....
1517	“ 4¾ mi. N. W.....	J. McGinn, flowing well	142	1.9	“	“	....
1518	“ 5 mi. W...........	O. B. Anderson, flowing well	147	2.1	“	“	....
1519	Waln't Grove 5½ mi. S.E	Minor Earl, drilled well	277	1.8	“	“	.12
1520	“ “ 2½ mi. S.E	E. Sanderson, drilled well	250	2.1	“	“	.14
1521	“ “ 4½ mi. S.E	Geo. Frost, drilled well..	140	1.4	“	“	.12
1522	“ “ 8 mi. S.E..	Joe Enstad, drilled well.	211	2.0	“	S. trace	18
1523	Lamberton 2 mi. S.......	F. Schandre, drilled well	166	1.95	“	Absent	....
1524	“	City well, drilled well...	180	7.9	Strong	Strong	.198
1525	“ 2 mi. N. E. .	Big Cottonwood River ..	......	.15	Absent	Absent	....
1526	“ 8 mi. N. E...	Mike Dooner, drilled well	......	.20	“	“	....
1527	“ 9 mi. N. E...	Wanda Creamery, drilled well................	188	4.3	“	“	.12
1528	“ 3 mi. N. W..	C. H. Works, drilled well	163	7.3	“	“	.23
1529	“	City tap..................	......	7.9	Strong	Strong	....
1530	“	Melted ice, Cottonwood River	......	.15	Absent	Absent	....
1531	“ ¾ mi. S......	Ole Frederickson, drilled well	150	6.5	“	“	....
1532	“ 1 mi. S.......	Jno. Wooley, drilled well	150	7.6	“	“	....
1533	“ 5½ mi. S.....	H. Roth, drilled well. ...	230	.80	“	Strong	....
1534	“ 6 mi. S. E....	H. Halter, drilled well..	137	.80	Trace	“	....
1535	“ 9 mi. S. E....	Tom Halter, flowing....	100	.40	S. trace	Absent	....

† Approximately.
‡ Tank Sample.

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1536	Lamberton, 8½ mi. S. E..	Aug. Wigener, drilled..	200	1.0	Trace ..	Absent.	.12
1537	" 11½ mi. S. E.	C. Kron, flowing well....	140	0.25	"	"	.09
1538	" 13 mi S	Mrs. Larson, drilled well	132	3.1	V. str'g.	"	.09
1539	" 12 mi. S......	Wm. Steneberg, spring..	......	.15	Trace ..	"	....
1540	" 11 mi. S. W..	Mike Johnson, drilled...	150	.55	"	"	.165
1541	" 6 mi. S. W...	M. Reardon, drilled......	190	.90	Absent.	"	....
1542	Walnut Grove..........	Master's, spring..........	......	.15	S. trace.	S. trace.	....
1543	" " 1 mi. N.....	Plum Creek.............	......	.45	Distinct	Strong..	....
1544	" " 2 mi. N.W..	L.W. Breckenridge, flow.	160	2.0	Absent.	Absent.	....
1545	" " 7 mi. N.W..	E. Wilson, flowing	225	3.0	"	"	....
1546	" " 7¼ mi. N.W	Mrs. J. Larson, flowing..	195	3.7	"	Trace .	....
1547	" " 9½ mi. N.W	C. J. Nelson, flowing....	195	5.5	"	Absent.	....
1548	" " 11¼ mi. N..	Otto Zeng, drilled well..	180	4.2	S. trace.	Trace ..	....
1549	" " 12 mi. N....	Ourada's, drilled well...	198	6.8	Absent.	Absent.	.077
1550	" " 9 mi. N.....	Fred Radtke, drilled well	300	8.7	"	"	....
1551	" " 7 m. N. E...	Knight's, drilled well....	165	7.3	"	"	....
1552	" " 6½ mi. N.E.	Linderberg's, flowing....	150	2.7	"	"	....
1553	" "	Village well, drilled.....	215	2.1	Distinct	Marked	.50
1554	" "	School well, flowing.....	290	2.05	Marked	Distinct	.13
1555	" "	R. R. well, drilled........	200	2.8	Strong..	Absent.	.20
1556	" "	Plum Creek, ice..........	......	.75	Absent.	"	....
1557	Vesta, 2 mi. S. W........	Redwood River..........	......	.15	"	"	....
1558	" 12 mi. S. W........	S. Moulten, drilled.......	125	11.6	"	Trace .	....
1559	" 13½ mi. S. W......	D. Christianson, drilled .	185	19.5	"	Marked	....
1560	" 14 mi. S. W........	Mr. Muhl, drilled........	125	18.5	"	S. trace.	.20
1561	" 13¼ mi. S. W......	Mr. C. J. Sponge, drilled	155	19.0	Absent.	Absent.	.20
1562	" 6 mi. W...........	M. Busehard, drilled....	100	.6	S. trace.	S. trace.	....
1563	" 1½ mi. N. E.......	Jno. Cotwell, bored......	90	.25	Marked	Distinct	....
1564	Delhi, 1 mi. E............	Geo. Lesley, drilled......	140	.10	Absent.	Absent.	....
1565	" 2 mi. E..........	Jno. Anderson, spring...	......	.05	S. trace.	"	.11
1566	" 2½ mi. N. E........	Minn. River	......	.30	Absent.	"	....
1567	" 4½ mi. N. E..	F. M. Shoemacker, spring I...............	......	.35	"	"	....
1568	" 4 mi. N. E..........	F. M. Shoemacker, spring II................	......	0.70	Trace ..	"	....
1569	" 4½ mi. N. E........	F. M. Shoemacker, spring III	......	0.10	Absent.	"	....
1570	" 4¾ mi. N. E........	C. Tolzman, drilled well	150	1.0	"	"	...
1571	" 4¾ mi. N. E.......	Tolzman's spring........	......	.30	Strong..	S. trace.	....
1572	" 12 mi. N. W.......	Minnesota river..	......	.30	S. trace.	Absent.	....
1573	Echo, 8 mi. N. E.........	Gemstad's spring, 1.....	......	.30	Trace ..	Trace ..	.198
1574	" 8 mi. N. E,.........	" " 2.....	......	.30	Distinct	Marked	....
1575	"	Minn. riv. ice, f'm Morton	......	.10	S. trace.	Absent.	.19
1576	"	Town tap................	......	1.8	Marked	Strong..	....
1577	Morton..................	Thos. Leary's spring....	......	.10	Absent.	Absent.	.30
1578	"	R. H. Kepton's dr. well..	100	1.8	Marked	Distinct	.13
1579	"	Father Egan's dr. well ..	60	6.1	Absent.	Absent.	.36
1580	" ½ mi. N.W......	Roadside spring, 1.......	......	.15	S. trace.	"	....
1581	" ½ mi. N.........	" " 2.......	......	.20	Distinct	"	....
1582	" 1 mi. W..........	W. Busch's spring, 1.....	......	.15	S. trace.	S. trace.	.066
1583	" "	" " 2....	......	.15	Marked	Absent.	....
1584	" "	" " 3....	......	.20	"	Distinct	....
1585	" "	" " 4....	......	.15	"	Absent.	....
1586	" 1¼ mi. W........	C. Reneke's spring	......	.75	"	Marked	....
1587	" 2½ "	J. Drips' spring..........	......	.15	"	Absent.	.17
1588	" 5 mi. W	Minnesota river.........	......	.35	Absent.	"	.836
1589	" 8½ mi. N. W....	Stepka, drilled well......	140	.30	"	"	....
1590	" 10 mi. N.........	F. Surba's spring........	......	.20	"	"	.26
1591	" 11 mi. N. E......	F. Ederer's drilled well.	190	3.0	"	"	.34
1592	" 9 mi. N	T. Kennedy's " " .	86	1.0	Distinct	Trace ..	....
1593	" 7 "	Pat Ryan's " " .	90	1.3	Marked	"	....
1594	" 1½ "	Jno Ederer's " " .	156	.10	Trace .	Distinct	.14
1595	"	R. R. eating house, drove	6	4.5	Strong..	"	....
1596	"	" " "	5	3.5	"	Marked	....
1597	"	Revere House, drove....	30	10.0	V. str'g	Distinct	....
1598	"	P. H. Galle, dug	24	6.0	Strong..	"	....
1599	" ½ mi. S.E.......	Roadside spring, 1.......	......	.15	Absent.	Absent.	....
1600	" 2 "	J. Preston's spring......	......	.45	Marked	Distinct	....
1601	" 3½ "	C. Kalbow's spring......	......	.25	Distinct	Absent.	....
1602	" 5 "	Roadside spring, 2.......	......	.15	S. trace.	Trace ..	....
1603	" 6 "	Jno. Larson's spring.....	......	.30	Trace ..	Absent.	....

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1604	Morton, 7 mi. S. E........	Minn. river at Franklin.	......	.65	Absent.	Absent.	.80
1605	" 6½ "	H. Johnson's spring.....	......	.25	S. trace.	Trace ..	....
1606	" 7 "	E. Thompson's spring...	......	.40	Absent.	Absent.	....
1607	" 7½ "	E. Halvorson's spring, 1.	......	.35	S. trace.	"	....
1608	" 7½ "	" " 2.	......	.45	Distinct	Distinct	....
1609	Franklin................	Town well, drilled.......	122	.10	Marked	Absent.	.14
1610	Morton, 2½ mi. E........	J. P. Patten, drilled.....	85	.15	S. trace.	"	....
1611	"	W. Miller, dug well	35	2.7	Strong..	S. trace.	....
1612	"	Jno. Simpson, dug well..	45	4.4	V. st'ng	"	....
1613	"	Mary Imdle, well........	100?	10.7	"	Absent.	....
1614	"	C. H. Hopkins, bored....	14	14.0+	"	"	....
1615	Fairfax................	B. L. Berg, dug...........	24	13.2	"	Trace ..	....
1616	"	P. Hanson, dug..........	26	9.6	"	Distinct	....
1617	"	Dr. Lee, drilled well....	98	.30	Absent.	Absent.	....
1618	"	R. G. Rainke, bored.....	75	3.6	Strong..	S. trace	....
1619	"	Town tap	......	1.1	Absent.	Absent..	.34
1620	"	Town well, drilled..	170	.30	"	"	.28
1621	" 3 mi. N. W......	H. Frickson, " ..	150	.25	Faint tr	"	....
1622	" 4 " " ...	Jno. Mundahl, " ..	140	.15	Absent.	"	....
1623	" 8 " " ...	F. McPharlan, " ..	140	.30	Marked	S. trace.	....
1624	" 15 " " ...	J. Ford, " ..	150	3.7	Trace...	Absent..	....
1625	" 18 " " ...	Chas. Gleason, " ..	202	2.0	Distinct	Distinct	....
1626	" 15 " N. E.......	A. P. Anderson, " ..	100†	.10	S. trace.	S. trace.	....
1627	" 14¼ " "	AndreAnders.n, " ..	198	.10	Absent.	Absent..	....
1628	" 13 " N.	Wm. Swartz, " ..	80	.10	S. trace.	"	....
1629	" ½ " E.	Jno. Donahue, " ..	155	.55	Absent.	"	....
1630	"	Creamery well, " .	175	.30	"	"	....
1631	"	J. Maxwell, drl'd & bor'd	200	7.0+	Strong .	Strong..	....
1632	"	Flour mill, drilled..	217	.30	Absent.	Absent..	....
1633	Winthrop................	City well, " ..	240	.10	S. trace.	"	.40
1634	"	City tap, " ..	......	.10	"	Trace...	....
1625	Gibbon................	City well, " ..	207	.60	"	Absent..	.34
1636	"	Flour mill, " ..	210	.45	Trace ..	Trace...	.27
1637	"	J. E. Peterson, " ..	205	.20	Absent.	S. trace.	....
1638	" 1½ mi. W........	J. Monson, " ..	155	.20	S. trace.	Absent..	.27
1639	" 4½ " S. W......	M. Christerfeson, " ..	160	.15	Distinct	Distinct	....
1640	" 8 " "	Carl Black, " ..	210	.45	S. trace.	Absent..	.26
1641	" 9 " "	Jno. Arhart, " ..	200	.75	Absent.	"	.27
1642	" 9½ " "	Jno. Antoine, " ..	......	.80	Marked	Marked.	....
1643	" 9½ " "	L. Green, " ..	220	.70	Trace .	Distinct	....
1644	" 9 " S.	Geo. Stadther, " ..	245	.65	Absent.	Trace...	....
1645	" 7½ " "	Nick Franta, " ..	170	.65	Marked	Distinct	....
1646	" 7½ " "	Clear Lake, So. End.....	......	.45	Trace ..	Absent..	....
1647	Winthrop, 2½ mi. S....	A. L. Anderson, drilled..	300	.50	Absent.	"	.33
1648	" 4 " N....	H. Kreuger, " ..	166	.10	"	"	.33
1649	" 4¼ " " ...	G. Hildebrand, " ..	160	.15	Strong .	Distinct	....
1650	" 5 " " ...	G. Roepke, " ..	160	.10	Absent.	Absent..	....
1651	" 5 " " ...	Gus Ellig, " ..	157	.10	"	"	....
1652	" 5 " " ...	H. Breefneck, " ..	160	.50	"	"	....
1653	" 5 " " ...	Wm. Meyer, " ..	370	.60	"	"	.26
1654	" 12 " N. W.	L. Penk, " ..	250	3.0	S. trace.	"	1.15
1655	" 13 " N....	Round Grove Creamery, drilled..................	112	.30	"	S. trace.	.26
1656	" 9 " " ...	C. Kujus, bored.........	48	.20	Trace ..	"	....
1657	" 8 " " ...	Penninround Grove Creamery, drilled..	128	.10	Absent.	Absent..	....
1658	" 8½ " " ...	Chris Otto, " ..	100	.30	S. trace.	"	....
1659	" 10 " " ...	W. Biecht, " ..	.....	.10	"	"	...
1660	" 10 " N. E.	Carl Maass, " ..	127	.10	Absent.	"	....
1661	" 11 " "	F. F. Gaulke, " ..	78	.10	"	"	....
1662	" 11½ " "	Pommer Cheese Factory, drilled	160	.10	"	Trace...	....
1663	" 9 " "	L. Jalke, drilled.........	147	.10	"	Absent..	....
1664	" 5 " "	K. F. Whalen, drilled...	342	.80	"	"	.16
1665	" 2 " "	Mrs. E. A. Campbell, bor.	......	.10	S. trace	Distinct	....
1666	"	C. S. Johnson, dug.......	20	5.5+	V. str'g.	"	....
1667	"	Mill well, drilled........	185	.10	Absent.	Absent..	....
1668	"	Seiter Hotel, dug........	......	5.5+	V. str'g.	Marked.	....
1669	"	Windsor Hotel, dug.....	28	5.5+	"	Trace ..	....
1670	"	H. E. Walker, driven....	12	16.0+	"	Distinct	....
1671	"	M. P. Nelson, bored......	14	16.0+	"	Trace ..	....

† Approximately.

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1672	Winthrop................	Mr. Swenson, well.......	......	.60	Strong..	Distinct	....
1673	“	Groebner's Cistern......	......	.60	Marked	“	....
1674	“	H. Kiesling, dug.........	40	.40	Strong..	“	....
1675	“	C. A. Benson, bored.....	122	2.25	“	Absent..	....
1676	“	Wm. Dretsko, dug	25	8.5	V. str'g.	S. trace.	....
1677	“	Bergert, dug	12	3.5	Strong .	“	....
1678	“	J. Lundquist, bored.....	54	7.5+	V. str'g.	Strong..	....
1679	“	Lundquist, No. 2, dug...	......	5.5	Strong..	Absent..	....
1680	“	“ “ 3, “ ...	......	11.5	V. str'g.	“	....
1681	“	L. J. Larson, bored......	35	.30	Marked	“	....
1682	“	W. Dunning, bored......	50	1.5	“	S. trace.	....
1683	“	W. Lundquist, dug.....	......	1.0	Distinct	Absent..	....
1684	“	C. M. Peterson, dug......	32	1.5	Marked	“	....
1685	“	H. C. Canfield, bored....	32	.30	Strong..	Distinct	....
1686	“	School well, bored.......	32	.25	“	Absent..	.18
1687	“	F. A. Osborne, dug......	50	1.0	“	S. trace.	....
1688	“	C. H. Hillman, dug......	25	19.0	“	Strong .	....
1689	“	J. Sherer, dug...........	30	8.5	V. str'g.	S. trace.	....
1690	“	F. J. Buschard, bored...	75	1.5	Strong..	Marked.	....
1691	Gaylord, 2 mi. N. W ..	F. Lewrenz, bored.......	143	.10	Absent.	Absent..	....
1692	“ 5½ “ “	J. Whalen, drilled........	......	.10	“	“	....
1693	“ 6 “ “	L. Burgard, drilled......	160?	.40	Marked	Distinct	....
1694	“ 5 “ “	F. Burgard, Jr., drilled..	174	.10	Absent.	Absent..	....
1695	“ 5½ “ “	Aug. Gruenwald, drilled	290	.10	“	“	....
1696	“ 6½ “ “	Chas. Goetch, drilled....	127	.10	Trace ..	S. trace.	....
1697	“ 6½ “ “	Roadside, dug, No. 1.....	......	.10	Marked	Trace ..	....
1698	“ 6½ “ “	“ “ “ 2.....	......	1.0	Strong..	Distinct	....
1699	“ 6½ “ “	Skim Station well.......	......	.10	Absent.	Trace...	.16
1700	“ 7 “ “	Mrs. Kuehl, drilled......	......	.25	“	Absent..	....
1701	“ 7½ “ “	Strich, drilled..........	184	.25	Strong..	“	....
1702	“ 10 “ “	N. Shore High Is. Lake.	......	.40	Absent.	“	....
1703	“ 10 “ “	M. A. Campbell, drilled.	240	.15	S. trace.	“	....
1704	“ 10 “ “	T. Vaghn................	145	.15	Absent.	“	....
1705	“ 9 mi. N........	A. A. Hubbard, well....	150	.10	“	“	....
1706	“ 7 “	High Is. Lake, S. shore..	......	.10	“	“	....
1707	“ 7 mi. N. E......	John Polcin, drilled......	134	.10	“	“	....
1708	“ 6 mi. N.........	Mrs. R. Ecker, drilled..	153	.10	Trace	“	....
1709	“ 5 mi. N. by N. E.	Jack Rose, drilled.......	170	.10	S. trace	“	....
1710	“ 5 “ “	H. Schaetz, drilled......	323	.10	Absent	“	....
1711	“ 4¼ mi. No. by N. E..........	H. Guildermeister, drilled..................	325	.10	“	“	.10
1712	“ 4¼ mi. N.......	H. Groechow, drilled....	341	.10	“	“	....
1713	“ 3¾ “	H. Greaves, drilled......	350	.20	“	“	....
1714	“	Albert Ecker, drilled....	132	.10	“	“	....
1715	“ 3 mi. N. W.....	Lake Titlo, ice...........	......	.10	Marked	“	.46
1716	“ 1½ mi. S. W...	H. Zimmerman, drilled.	200	.10	S. trace	S. trace	...
1717	“ 2¼ “ ...	H. Maass, drilled........	165	.10	Absent	“	....
1718	“ 3½ “ ...	Patrick Mee, bored......	70	1.0	S. trace	Absent	....
1719	‘ 3½ “ ...	Patrick Mee, dug.........	50	4.5	Strong	Distinct	....
1720	“ 3½ “ ...	John Mee, dug...........	20	5.5	“	“	....
1721	“ 3½ “ ...	John Mee, bored.........	90	3.0	“	Trace	....
1722	“ 6 mi. S. W.....	L. G. Becklund, drilled.	160	.30	Absent	Absent	....
1723	“ 9 “	John Head, drilled......	200	.40	“	“	....
1724	“ 9½ “	C. O. Gustason, well.....	......	.60	“	“	.14
1725	“ 11 “	John Isaacson, drilled...	205	.20	“	“	. ..
1726	“ 9 mi. S.........	C. C. Nelson, drilled.....	200	.25	“	“	....
1727	“ 9 “	P. M. Tegner, drilled....	215	.60	“	“	....
1728	“ 10 “	New Sweden creamery, drilled..................	260	.50	“	“	....
1729	“ 10½ mi. S. by S. E..........	M. Peterson, drilled.....	240	.40	“	S. trace	....
1730	“ 10½ mi. S. by S. E..........	M. Olson, drilled.........	200	.40	“	Absent	....
1731	“ 12 mi. S. E.....	Lars Peterson, drilled...	196	.15	Marked	“	....
1732	“ 15 “	J. H. Randall, drilled...	188	.15	Absent	“	....
1733	“ 10 “	John Pierson, drilled....	162	.20	S. trace	“	....
1734	“ 8 “	T. A. Torgeson, drilled..	220	.30	“	“	....
1735	“ 3½ “	Geo. Kuehler, drilled ...	165	.40	“	“	....
1736	“ 1 mi. S.........	Wm. Schuppenhust, drilled	85	.10	Absent	S. trace	....
1737	“	John Geib, drilled.......	210	.10	“	Absent	....

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1738	Gaylord	Village well, drilled	302	.10	Absent..	Absent.	.14
1739	Arlington, 2 mi. S.......	R. Meyer, drilled........	285	.15	"	"	....
1740	" 2¼ "	Wm. Maass, drilled.....	......	.15	"	S. trace	....
1741	" 2½ "	H. Weike, drilled........	280	.15	"	Absent	....
1742	" 2½ "	F. W. Witte, drilled.....	150	.15	"	"	....
1743	" 3 "	Wm. Nagel, drilled......	100†	.15	"	"	....
1744	" 6 '	G. Weckworks, drilled..	......	.15	"	"	....
1745	" 6 "	New Rome Creamery, drilled..................	257	.15	"	"	.12
1746	" 7½ "	Peter Geib, drilled......	123	.15	"	"	....
1747	" 9½ "	J. Wetsig, drilled........	125	.15	"	"	....
1748	" 11½"	E. Reneke, drilled.......	200	.30	"	"	....
1749	" 18 mi. S......	Norseland cream'y, dr'd	200	.20	Marked.	"	....
1750	" 18 "	" P. O., drilled..	180	.20	"	"	....
1751	" 18 "	S. A. Johnson, " ..	180	.20	"	"	....
1752	" 18 "	Sand Lake..............	......	.30	Absent.	"	....
1753	" 17¾ mi. S. E..	H. Benson, drilled.......	172	.20	"	"	....
1754	" 18 mi. S......	Ole Strand "	206	.20	"	Marked.	....
1755	" 16 "	Mr. Hoff, "	......	.30	"	Absent.	....
1756	" 14 mi. S. E ...	Andrew Pierson, drilled	208	.20	"	"	....
1757	" 16 "	Matt. Welter, "	200	3.5	S. trace.	S. trace.	.24
1758	" 11 "	Rush River cream., "	150	.30	Absent.	"	....
1759	" ½ mi. N.	Chas. Hillman "	312	.35	"	"	....
1760	" 2½ "	R. Walters' spring......	......	.35	Strong.	Mark ed.	....
1761	" 2½ "	J. Sullivan, drilled......	115	.20	S. trace.	Absent.	....
1762	" 2 "	Frank Thomas "	95	.10	"	"	....
1763	" 4 "	Lichtner "	213	.35	Absent.	S. trace.	.18
1764	" 4 "	Tuchtenhagen "	111	.10	S. trace.	Absent.	....
1765	" 3½ "	Chris Boetcher "	210	.20	Absent.	"	.12
1766	" 4 "	A. A. Schoeming, bored.	105	.20	Marked.	Marked.	....
1767	" 6 "	Mike Kaufmann, drilled	94	.15	Trace ..	Absent.	....
1768	" 8 "	F. Voigt's well..........	......	1.0	Marked.	Distinct	....
1769	" 8 mi. N. E....	Severance Lake.........	......	.20	S. trace.	Absent.	....
1770	" 9 mi. N.......	Mr. Voss, drilled	234	.20	Absent.	"	....
1771	" 9 "	H. Lange, "	210	.20	S. trace.	"	....
1772	" 9 "	H. Dammann, drilled....	210	.20	"	"	....
1773	" 12 mi. N. E...	Lake Washington.......	......	.30	"	"	....
1774	Green Isle...............	Town well, drilled.......	172	.20	"	"	....
1775	"	Railroad well, drilled...	347	.20	Absent.	S. trace.	....
1776	"	Grist mill, " ...	210	.20	"	Absent.	....
1777	Arlington, 9 mi. N. E....	Jno. Fahey, " ...	130	.20	"	"	....
1778	" 6 "	Jas. Welsh, " ...	130	.20	S. trace.	"	....
1779	" 5 "	Mike Fahey, dug........	40	1.0	Marked.	Distinct	....
1780	" 5 "	" drilled.....	330	2.3	V. st'ng	Absent.	2.32
1781	" 5 "	Silver Lake..............	......	.50	Absent.	"	....
1782	" 7 mi. E........	M. Bergert, drilled......	330	.20	"	"	....
1783	"	Mr. Buck, dug...........	......	.50	V. st'ng	Distinct	....
1784	"	H. Feldman, dug........	......	55.0	"	Marked.	...
1785	"	Union Hotel, "	25	2.0	"	Trace ..	....
1786	"	City Hotel, "	33	2.5	"	S. trace.	....
1787	"	Street corner well, dug.	90?	1.6	"	Distinct	....
1788	"	Arlington House, "	......	1.2	"	Trace ..	....
1789	Henderson, 1 mi. S......	Brewery spring..........	......	.40	Trace ..	S. trace.	....
1790	" 3 "	Berle's Lake.............	......	.30	S. trace.	Absent.	.48
1791	" 3 mi. S. W..	Fred Lieske, drilled....	125	.20	"	"	....
1792	" 3½ " ..	L. Lieske, "	143	.15	"	"	....
1793	" 5 " ..	Wm. Meisener, "	310	.15	"	"	....
1794	" 7 " ..	Hoffmeister "	144	.15	Absent.	"	....
1795	" 6½ " ..	C. Blaising, "	332	.15	S. trace.	"	....
1796	" 6 mi. W.....	Wm. Sangert, "	150	.15	"	"	....
1797	" 5 mi. W.....	Ed. Wiemen, drilled....	330†	.15	"	"	....
1798	"	Minn. river at bridge...	......	.95	Absent.	"	....
1799	" ¼ mi. E.....	G. Brand, drilled........	380	.45	Marked	"	.15
1800	" 3 " ".....	A. Crosby, "	265	.15	"	"	....
1801	" 5 " ".....	Wm. Tregs, "	288	.30	Absent.	"	....
1802	" 6 " ".....	Carl Liptke "	300	.25	Distinct	S.trace..	....
1803	" 2 " N	Roadside Spring.........	......	.25	S. trace	"	....
1804	"	Merchants Hotel, dug..	30	8.0	V stro'g	Marked.	....
1805	"	Livery Stable used by Hoffmann House......	25	10.0+	"	"	....
1806	"	City well, flowing........	700	1.1	Absent.	Absent	.228

† Approximately.

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Chlorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1807	Belle Plaine, 7 mi. S.....	Jno. Kessler, drilled....	270	.40	Distinct	Distinct	....
1808	" " 3½ " S. W.	Jno. Westphal, drilled..	175	.10	Marked	"	....
1809	" " 3½ " "	Ed. Malz, drilled........	325	.10	Distinct	Trace ..	....
1810	" " 1 " S.....	Jno. Lutske.............	147	.25	Absent.	Absent.	....
1811	" "	Town well, drilled	200	1.7	Distinct	"	.112
1812	" "	Town tap	......	1.7	"	Trace...	.137
1813	" "	Minn. River	......	2.7	Absent.	Absent..	.68
1814	" " 3 mi. N. W..	Stephen Smith, drilled..	223	.10	Trace..	S. trace.	....
1815	" " 3 " " ..	A. Donovan, " ..	240	.10	Absent.	Marked	....
1816	" " 6 " W.....	J. O'Neil, " ..	252	.10	"	Absent..	....
1817	" "	Rev. Maser, " ..	226½	.45	S. trace	"	....
1818	" "	Depot well, drove.......	35	.90	"	"	....
1819	" "	Salt Springs	......	.35	Absent.	S. trace.	....
1820	" "	Wm. Lotski, drilled.....	130	.80	"	Absent..	....
1821	" "	Sam Bowler, well........	......	3.00	Marked	"	....
1822	" " ½ mi. N. E..	Brewery well, drilled...	88	.30	Absent.	"	....
1823	" " ½ " " ..	Roadside spring, No. 1..	.....	.20	Marked	S. trace.	....
1824	" " ½ " " ..	Hoopers Lake...........	......	.15	Absent.	Absent..	....
1825	" " ½ " " ..	Roadside Spring 2.......	......	.15	Marked	"	....
1826	" " ½ " " ..	" " 3.......	......	.15	"	"	....
1827	" "	R. Stratton, drilled......	184	.45	Absent.	"	.14
1828	" "	Orphans' Home "	180	.15	"	S. trace.	....
1829	" " ¾ mi. E ..	P. H. Fahey "	140	.25	Strong..	Trace ..	....
1830	" " 2¼ " " ..	Jno. Bliss, spring........	......	.15	"	S. trace.	....
1831	" "	Ice from Hoopers Lake.	......	.10	S. trace	Absent.	....
1832	Jordan, 2 mi. S. W......	Mrs. J. Hawes, spring...	......	.30	Marked	"	....
1833	" 4 " "	W. Lowe, spring.........	......	.10	Absent.	S. trace.	....
1834	" 3½ " "	Spring No. 1, J. Erickson	......	.80	"	Marked	....
1835	" 3½ " "	J. Erickson, Spring 2....	......	.70	"	S. trace	....
1836	" 3½ " "	Strait's Lake......	......	.10	"	Absent.	....
1837	" 2¾ " W.......	Minnesota River........	......	3.5	"	"	....
1838	" 2¾ " "	Spring No. 1 on Minn. Ri.	......	.90	Marked	"	....
1839	" 2¾ " S. W.....	" 2 " "	......	.90	"	Distinct	....
1840	" 2¾ " "	" 3 " "	......	.30	Strong..	Absent.	....
1841	" 2¾ " "	" 4 " "	......	1.3	Marked..	Trace ..	.18
1842	" 2 " "	" 5 " "	......	.80	"	Distinct	....
1843	" 2 " "	" 6 " "	......	.40	"	Absent.	....
1844	" 2 " "	" 7 " "	......	.40	"	S. trace.	....
1845	"	Quarry spring..........	......	1.4	S. trace	"	....
1846	" ½ mi. S..... ..	Upper dam of Sand cr..	......	.20	Absent	Absent	....
1847	" 2 "	Roadside spring.........	......	.20	S. trace	"	....
1848	" 4 "	H. Leopold, drilled......	100	.20	Absent	"	....
1849	" 4½ "	Sand creek..............	......	.20	Marked	Distinct	....
1850	" 7 "	C. O. Kernick, drilled...	160	.20	Distinct	Marked	....
1851	" 7¼ "	R. Kernick, " ...	255	.30	Absent	Absent	....
1852	" 7½ mi. S. E.....	F. Dickman, well	155	.20	"	"	....
1853	" 9 mi. S	F. Wermerskirchen, well	120	.20	S. trace	"	....
1854	New Prague.......... .	New Prague Ice Pond...	......	5.5	Trace	"	....
1855	"	City well, drilled........	390	.10	Absent..	"	.12
1856	"	City tap..................	......	.10	S. trace	"	....
1857	" 6 mi. N. E,..	Cedar Lake..............	......	.10	"	"	....
1858	Jordan, 2½ mi. N........	A. Novotney, spring....	......	.20	Marked	S. trace	....
1859	" 7 "	J. B Conter, drilled.....	120	.60	Strong	Trace	....
1860	" 7½ "	M. Grundhoefer, drilled	145	.20	Absent	Absent	...
1861	" 8 "	H. Jaenicke, "	140	.25	"	"	....
1862	" 9 "	M. De Ville, "	108?	1.0	Strong	"	....
1863	" 9½ "	Jno. Schneider, "	160	.30	Absent	"	....
1864	" 10 "	H. Lenzmeier, "	120	.30	"	"	....
1865	Shakopee................	Minn. Rv. at Shakopee..	......	3.8	S. trace	"	....
1866	"	Spring, No. 1, " ..	......	.60	Absent	"	....
1867	"	Spring, No. 2, " ..	......	.60	"	"	....
1868	"	Shakopee, C. H., drilled.	90	.60	"	"	....
1869	" 3 mi. N. E......	Duffy's, drilled?.........	76	1.0	Strong	"	....
1870	Prior Lake...............	Prior Lake (S. E.).......	......	.20	Absent	"	.40
1871	"	Village well, drilled....	110	.20	S. trace	"	....
1872	Jordan, 15 mi. E........	L. B. Cates, "	100	.20	Absent	"	....
1873	" 14 "	Spring Lake.............	......	.15	"	"	....
1874	" 4 "	J. K. Lehr, drilled......	180	.10	Marked	Distinct	....
1875	" 3 "	Jos. Seifert, "	180	.10	S. trace	Absent.	....
1876	" 2½ "	F. Maerz, "	213	.20	Absent	"	....
1877	" 2 "	Mike Goebel. "	209	.20	"	"	....

FIELD ANALYSES—*Continued.*

Number.	Where Taken.	Name and Description.	Depth.	Colorine.	Nitrates.	Nitrites.	Consumed Oxygen.
1878	Jordan, 2 mi. E.	P. Gregory, drilled	220	.30	Absent	Absent	....
1879	"	Merchants Hotel, drilled	52	.30	"	"	.12
1880	"	American House, dug	20	11.0	"	Distinct	....
1881	"	C. Boxmeyer, "	20	5.30	Strong	"	....
1882	"	Lower dam of Sand cr.	......	4.40	Absent	"	....
1883	Glenwood	1st creek, East	......	.10	"	"	....
1884	" ½ mi. S.	Creek, No. 2	......	.15	"	"	....
1885	" ¼ "	Ward's spring	......	.10	"	"	....
1886	" 1½ "	Spring No. 2	......	.15	"	"	....
1887	" 2 "	Fertney's spring.	......	.30	Trace	"	....
1888	" 2½ mi. S.	Halvorson, spring 1	......	.20	Absent	Absent	....
1889	" 2¾ "	Halvorson, spring 2	......	.30	"	Trace	....
1890	" 3 "	Y. M. C. A., spring 1	......	.15	"	Absent	....
1891	"	Y. M. C. A., spring 2	......	.15	"	"	....
1892	"	Y. M. C. A., spring 3	......	.15	"	"	....
1893	" 3½ mi. S.	Stewart's spring	......	.15	"	"	....
1894	"	Lake Minnewaska	......	.35	S. trace	"	....
1895	"	Fjelstad, flowing	135	.20	Trace	"	....
1896	"	Academy, flowing	70	.20	Absent	"	....
1897	"	First creek west	......	.10	"	"	....
1898	" ½ mi. W.	First spring west	......	.10	"	"	....
1899	" ¾ "	Eagle Point spring	......	.10	"	"	....
1900	"	Eagle Point spring, 2	......	.10	"	"	....
1901	"	Creek No. 2	......	.10	"	"	....
1902	" 2 mi. W.	Sulphur creek	......	.10	"	"	....
1903	"	Sulphur creek tributary	......	.10	"	"	....
1904	"	Sulphur spring	......	.10	"	"	....
1905	"	Rue farm, No. 2	......	.10	"	"	....
1906	"	Rue farm, No. 3	......	.10	"	"	....
1907	"	Rue farm, No. 4	......	.10	"	"	....
1908	"	Rue creek	......	.10	"	"	....
1909	"	Bartke's spring, 1	......	.10	"	"	....
1910	"	Bartke's spring, 2	......	.10	"	"	....
1911	"	Bartke's spring, 3	......	.10	"	"	....
1912	"	Bartke's spring, 4	......	.10	"	"	....
1913	"	Bartke's spring, 5	......	.05	"	"	....
1914	"	Bartke's spring, 6	......	.10	"	"	....
1915	"	Bartke's spring, 7	......	.10	"	"	....
1916	"	Bartke's spring, 8	......	.10	"	"	....
1917	" 4½ mi. N.	Jim Blair, bored well	115	.07	"	"	....
1918	" 5 "	Morrow's bored well	100	.07	"	"	....
1919	"	John Cooley, bored well	98	.05	"	"	....
1920	"	Reservoir	......	.10	Strong	Trace	....
1921	"	Tank spring	......	.05	"	Absent	....
1922	"	Reservoir spring	......	.05	"	"	....
1923	"	Sioux depot, well	80	.15	Absent	"	....
1924	"	Glenwood Bottling Co.	......	.10	Strong	Trace	.14
1925	New Ulm	Albrecht's drilled well	160	.40	Absent	Absent	....
1926	"	Durbhan's drilled well	150	.60	Distinct	Marked	....
1927	"	Oakland's drilled well	280	.50	Absent	Absent	....
1928	"	Siemmert's drilled well.	260	.30	Trace	Trace	....
1929	"	Welner, drilled well	175	.60	"	"	....
1930	"	Diebolten, drilled well	260	.20	"	"	....
1931	"	Slumberger, drilled well	320	.60	Absent	Absent	....
1932	"	Hoffman's drilled well	200	.20	"	"	....
1933	"	Roadside spring	......	.30	"	"	....
1934	"	Slaughter house, drilled	120	.20	"	"	....
1935	"	Hauenstein's, shallow, 1	37	1.20	"	"	....
1936	"	Hauenstein's, shallow, 2	37	1.20	"	"	....

SPECIAL FIELD ANALYSES FOR ST. CLOUD.

Number of Sample.	Name of Owner or Tenant.	Source.	Chlorine.	Nitrates.	Nitrites.	Ammonia Free.	Ammonia Albuminoid.
1	Mrs. Jno. Zapp	Dug well 45 ft. deep	2.3	Strong	Trace		
2	Wesley Carter	" " 20 " "	3.6	"	S. trace.		
3	J. S. Stevenson.	" "	.31	Marked	Absent.	.001	.001
4	J. F. Bradford	Driven well 25 ft. deep	2.97	Strong.	"		
5	F. E. Kreatz	Dug " 25 " "	9.09	V. str'g.	Marked		
6	S. Reinhart	Driven " 26 " "	3.15	"	S. trace.		
7	N. Lahr	" " 8 " "	3.78	Strong.	Strong		
8	L. E. Wakeman	" " 14 " "	3.33	"	Marked		
9	Mrs. Shaffer	Dug "	2.16	"	Distinct		
10	Jno. Mick	" "	3.15	"	Absent.		
11	Jos. Hall	Driven "	3.96	"	"		
12	M. Kindler	" " 18 ft. deep	2.97	"	Trace		
13	Peter Spaniol	" " 20 " "	5.04	"	Strong		
14	Mrs. Bohner	" " 20 " "	2.43	"	S. trace.		
15	Julius Kindler	" " 20 " "	2.79	"	Distinct		
16	Puff Bros.	" " 20 " "	3.69	"	Strong		
17	F. X. Siepert	" "	2.79	"	Trace		
18	Adam Wagner	" " 12 ft. deep	1.89	"	Absent.		
19	Adolph Zaph	" " 22 " "	2.61	"	"		
20	J. Klein	" "	3.07	"	"		
21	Geo. Hillenbrand	" " 25 ft. deep.	1.62	"	Trace		
22	Mrs. Portius	" "	2.43	"	Absent.		
23	Wesley Carter	" "	2.07	"	"		
24	Comm. house (a)	" " 35 ft. deep	2.07	"	Trace		
25	Comm. house rear	" " 25 " "	2.50	"	Distinct		
26	Market hotel	" "	4.15	"	Absent.		
27	Sieberger	" "	2.61	"	Distinct		
28	Wesley Carter (Frankle saloon)	" "	3.06	"	"		
29	W. Carter (P. Muehler)	" "	3.51	"	Absent.		
30	An'x, Merchants hotel	" "	3.40	"	"		
31	Merchants hotel	" "	2.70	"	Marked		
32	Merchants hotel (tank sample)	" "	3.15	"	Absent.		
33	Mrs. Mecklen	" "	3.15	"	Marked		
34	Mrs. Mecklen (resid)	" "	3.24	"	Distinct		
35	Mooseberger	" "	2.43	"	Marked		
36	John Ran	" "	2.34	"	Absent.		
37	Barney Vossberg	Dug and driven	1.98	"	"		
38	Wm. Schmidt	Driven well 16 ft. deep	2.52	"	Distinct		
39	J. Dominik	" "	2.16	"	Trace.		
40	Gruber & Co.	" " 18 ft. deep	2.25	"	Absent.		
41	Matt. Neurenberg	" "	2.43	"	"		
42	M. Mutschler	" " 15 ft. deep	2.97	"	S. trace.		
43	M. Mutschler (rear)	" " 15 " "	2.25	"	Absent.		
44	Geo. Trzewik	Dug "	2.07	"	Trace		
45	Gerhard May	Drove "	2.07	"	Absent.		
46	A. Daniels, Jr	Dug "	2.07	"	S. trace.		
47	M. Leiser	Drove "	2.25	"	Absent.		
48	Jno. Lengas	Dug "	3.15	"	"		
49	Mike Miller		2.16	"	Marked		
50	H. S. Lyle	Drove "	2.16	"	Absent.		
51	Latsch	" "	2.07	"	"		
52	P. Kaesges	" "	1.98	"	"		
53	Paul Bransh		1.80	"	Strong		
54	M. Miller (resid.)	Dug " 14 ft. deep	2.75	"	Absent.		
55	C. G. Spicer	Drove " 14 " "	3.24	"	Strong		
56	W. H. Scruby	" " 14 " "	1.17	"	Absent.		
57	St. Mary, No. 1	" " 10 " "	.90	"	S. trace.	.009	.007
58	St. Mary, No. 2	" " 10 " "	1.62	"	Absent.		
59	Jos. Laudenbach		.72	"	"	.002	.006
60	Mr. Heinen		.72	"	"	.004	.005
61	Mike Varsky		.72	"	"	.002	.005
62	Jno. Zapp (Mrs. Glace)		.63	"	"	.004	.006
63	Jno. Herzing	Drove well 20 ft. deep	.63	"	"	.006	.007
64	Mr. Steins (Mrs. Glaesges)		.81	"	S. trace.	.007	.010
65	S. F. Pfeffer		1.71	"	Absent.		
66	Heinemann		1.71	"	"		
67	Jno. Joundel		1.89	"	"		

SPECIAL FIELD ANALYSES FOR ST. CLOUD.—*Continued.*

Number of Sample.	Name of Owner or Tenant.	Source.	Chlorine.	Nitrates.	Nitrites.	Ammonia Free.	Ammonia Albuminoid.
68	J. Gundermann........	....	1.18	Strong..	Absent.	......	......
69	Peter Schmidt.........	....	1.26	"	"	......	......
70	Mrs. Flannery..........	....	.72	"	"	......	......
71	Wm. Heimseth........	Drove well 20 ft. deep..	1.89	"	"	......	......
72	Mr. Huhn..............	Dug "	1.62	"	"	......	......
73	B. Reinhard...........	Drove " 15 ft. deep..	1.17	"	"	......	......
74	Chas. Kaerwer.........	" " 15 " " ..	1.62	"	"	......	......
75	Gales & Strober.......	" " 14 " " ..	.99	"	"	......	......
76	Wm. Walker...........	" " 15 " " ..	.36	"	"	......	......
77	Nick Pesch.............	Dug "	.63	"	"	......	......
78	Simon Stroten.........	Driven and dug well....	.45	"	"	......	......
79	M. Favrow.............	....	54	"	"	......	......
80	Fred Schepers..........	....	1.58	"	"	......	......
81	Jno. Hammerel, Jr....	....	1.53	"	"	......	......
82	Matt Jacobs............	Dug and drove well.....	1.53	"	"	......	......
83	Nick Brandenberger..	Drove well..............	1.62	"	"	......	......
84	Stephen Tenvorde	....	.99	"	"	......	......
85	P. Gotten (new house)	Drove well 16 ft. deep...	.54	"	"	......	......
86	P. Gotten (old house)..	" " 16 " " ...	.39	"	"	......	......
87	J. Teyner..............	" " 16 " " ...	1.62	"	"	......	......
88	Bisenius	" "	1.44	"	"	......	......
89	Nick Zurken...........	" " 16 ft. deep...	2.52	"	"	......	......
90	S. Neid..................	....	1.17	"	Strong .	......	......
91	L. Wahl..................	....	.36	"	Absent .	.006	.004
92	M. Hall..................	Drove well..............	.38	"	"	.010	.006
93	D. Hall..................	" "	.90	"	"	......	......
94	Paul Lein	" " 18 ft. deep....	1.98	"	"	......	......
95	Ice house (St. Germain Street)	....	1.71	"	"	......	......
96	Geo. Laurer	....	1.44	"	"	......	......
97	Jos. Betzold............	....	1.44	"	"	......	......
98	Jos. Beren..............	Drove well..............	5.85	"	"	......	......
99	A. L. Cramb...........	....	.13	Trace...	"	.002	.001
100	" " (B.& D. res)	....	1.62	Strong .	"	......	......
101	" " (Gaulke) ..	....	.54	"	"	.004	.003
102	" " (Robinson).	Drove well..............	.49	"	"	.006	.002
103	Father Gregory.........	" " 20 ft. deep....	.76	"	"	.010	.008
104	St. Mary Convent......	" "	.54	"	Trace...	......	......
105	Jno. Coates	" " 40 ft. deep....	1.80	V.str'ng	Absent..	......	......
106	Mrs. W. Rosenberger..	....	1.44	Distinct	"	.005	.004
107	Frank Lersen..........	....	2.43	Strong .	Marked	......	......
108	P. B. Gorman..........	Drove well 40 ft. deep...	2.25	"	Trace...	......	......
109	Mrs. Mayberry........	" "	1.53	Trace ..	Marked	......	......
110	A. Kraemer............	" " 25 ft. deep....	1.62	Strong .	Absent .	......	......
111	Mrs. M. Weber.........	" "	.90	"	"	......	......
112	403 6th Ave. So.........	....	1.08	"	"	......	......
113	Henry Becker..........	....	1.89	"	Distinct	......	......
114	Jno. Hedlund..........	....	2.16	"	Absent .	......	......
115	Chas. Peterson.........	....	2.25	"	"	......	......
116	Henry Puff............	Drove 16 ft. deep........	.99	"	"	......	......
117	Jno. McElroy..........	" 40 " "	1.35	"	S. trace	......	......
118	T. C. Alden	" 35 " "	.90	"	Absent .	......	......
119	511 6th Ave. So........	....	1.62	Marked	"	......	......
120	Albert Ellis............	....	1.98	Strong .	Distinct	......	......
121	Wm. Albrecht.........	Well, 30 ft. deep.........	.54	Marked	Absent .	.001	.001
122	Theo. Harker..........	" 20 " "	.40	Absent.	"	.006	.003
123	Mrs. Tschumperlin....	Sample refused..........	....	....	....	......	......
124	H. Bowing..............	Drove well..............	.63	Absent.	Absent .	.011	.004
125	W. Arnold	....	.81	Strong..	Marked	......	......
126	And. Benson...........	Dug well, 32 ft. deep	2.61	Marked	Absent .	......	......
127	Jno. Benson...........	Drilled well, 75 ft. deep..	.45	S. trace	"	.006	.001
128	Jno. Shaffer............	Dug " 27 " " ..	1.53	Strong..	"	.003	.004
129	W. H. Vye..............	" "	1.89	"	S. trace	......	......
130	Adam Schaum.........	" " 20 ft. deep..	.99	"	Absent .	......	......
131	John Wahl.............	Drove well, 15 ft. deep...	.49	Marked	Distinct	.005	.003
132	D. Morgan.............	" " 20 " ...	1.17	Strong .	Absent .	......	......
133	C. Capple	" "	1.17	"	Distinct	......	......
134	M. Reider..............	Dug well, 53 ft. deep.....	1.53	"	Absent .	......	......
135	C. Stanger.............	" " 52 "	1.80	"	Trace ..	......	......
136	Mrs. Quickstead.......	" " 50 "	2.16	"	"	......	......

SPECIAL FIELD ANALYSES FOR ST. CLOUD.—*Continued.*

Number of Sample.	Name of Owner or Tenant.	Source.	Chlorine.	Nitrates.	Nitrites.	Ammonia	
						Free.	Albuminoid.
137	Miss Knutson	Drove well	1.35	Strong..	Trace...	......	......
138	R. Berg	Dug well, 62 ft. deep	.90	"	Absent.	......	......
139	G. H. Griffin	Well	2.16	"	Distinct	......	......
140	F. B. Doten	Dug well, 40 ft. deep	.98	"	S. trace.	......	......
141	F. Hellier	" " 40 "	2.25	"	Absent.	......	......
142	M. Teller	" " 75 "	1.53	"	Trace ..	......	......
143	J. O. McConnell	Dug and bored, 32 ft. deep	1.80	"	Absent.	......	......
144	G. A. Deckman	Dug well, 48 ft. deep	1.80	"	"	......	......
145	Dr. Johnson	" "	.99	"	S. trace.	......	......
146	Geo. Young	Drove well, 50 ft. deep	.72	"	Absent.	.010	.006
147	G. Churchill	Dug well, 40 ft. deep	.45	"	Marked	.006	.009
148	Mrs. Biggerstaff	Drove well	1.89	"	Absent.	......	......
149	N. Geib	" "	1.89	Marked	Marked	......	......
150	O. H. Wood	" "	1.71	Strong..	Absent.	......	......
151	Mrs. Montgomery	......	2.07	"	"	......	......
152	W. B. Mitchell	Open well, 50 ft. deep	1.98	"	"	......	......
153	H. M. Moore	Dug well, 35 "	2.70	"	Strong..	......	......
154	John Becker	......	1.80	"	Distinct	......	......
155	Ed Zapp, 4th Ave. S.	Drove well	.99	"	S. trace.	......	......
156	D. E. Perkins	Dug well, 50 ft. deep	1.98	"	"	......	......
157	McMahon and Fritz	Open well, 35 ft. deep	1.44	"	Distinct	......	......
158	E. P. Long	Drove well, 56 ft. deep	1.17	"	Absent.	......	......
159	Dr. Beatty	" " 40 ft. deep?	1.80	"	Distinct	......	......
160	N. R. Hunt	Open well, 35 ft. deep	4.05+	"	"	......	......
161	J. Abel	Drove well, 100 ft. deep	.99	"	S. trace.	......	......
162	A. E. Gardner	Dug well, 50 ft. deep	1.35	"	Distinct	......	......
163	Marvin & Allen	" " 29 "	1.17	"	Trace .	......	......
164	913 4th Ave. So	......	1.17	S. trace.	Absent.	......	......
165	Rev. E. M. Johnson	Drove well, 34 ft. deep	1.89		"	......	......
166	W. M. Whitney	Drove well	2.25	Strong..	"	......	......
167	H. Maybury	......	1.35	"	"	......	......
168	W. S. Elliot	Drove well	2.70	"	"	......	......
169	McConnell Place	......	2.07	"	Distinct	......	......
170	J. L. Gray	Drove and dug well, 22 ft. deep	.90	"	S. trace.	......	......
171	Larson & Monk	Open bucket well	7.2+	"	Marked	......	......
172	L. Frost	Dug well, 50 ft. deep	5.4+	"	Distinct	......	......
173	E Cotter	......	.13	S. trace.	Absent.	.001	.001
174	M. P. Noel	Creek formed by spring.	.27	Strong..	Trace ..	.004	.003
175	Ed Racine	......	.36	"	Absent.	.004	.002
176	Eph. Robinson	......	1.19	"	"	......	......
177	A. Ressler	Dug well	.99	Marked	S. trace.	......	......
178	Chas. Orcutt	Drove well, 20 ft. deep	1.35	Strong..	Marked	......	......
179	A. M. Getchell	......	1.89	"	Absent.	......	......
180	J. David	Drove well, 18 ft. deep	1.26	"	"	......	......
181	Mrs. Carlson	" " 18 "	.99	"	"	......	......
182	Dan Harris	" " 18 "	1.17	"	"	......	......
183	E. J. Mix	Dug well, 32 ft. deep	.72	"	"	......	......
184	Jacob Wool	Drove well, 74 ft. deep	.58	"	Distinct	......	......
185	Oscar Zimmerman	" " 30 "	1.44	"	Absent.	......	......
186	A. G. Petrie	" " 90 "	.99	"	Marked	......	......
187	L. Mattson	Dug well, 56 ft. deep	3.60	"	Distinct	......	......
188	J. H. Jackson	" " 33 "	5.4+	"	"	......	......
189	John Rogers	" " 42 "	3.06	"	S. trace	......	......
190	Prof. Avery	" " 40 "	4.86	"	Trace ..	......	......
191	Hull's House	......	2.25	"	Absent.	......	......
192	Rockwood	Dug well, 57 ft. deep	.99	"	Marked	......	......
193	W. F. Knowlton	" " 44 "	1.26	"	Absent.	......	......
194	S. A. Grey	" " 50 "	4.77	"	Distinct	......	......
195	J. F. Bradford	Drove well, 25 ft. deep	3.06	"	S. trace	......	......
196	P. E. Kaiser	Drove well	4.77	"	Marked	......	......
197	418 4th Ave. So	" "	3.51	"	Absent.	......	......
198	A. F. Robertson	" " 48 ft. deep	3.06	"	"	......	......
199	C. F. Macdonald	Dug and driven	2.43	"	Marked	......	......
200	Mrs. Oliver	Drove well 70 ft. deep	2.07	"	S. trace.	......	......
201	McClure estate	" " 100 ft. "	.31	"	Absent.	.00	.00
202	Whitman	Dug " 70 ft. "	2.61	"	Distinct	......	......
203	Mrs. Brower	Cistern	.09	Marked	Marked	......	......
204	J. A. McDonald	Dug well 60 ft. deep	.67	Strong..	Trace ..	.00	.001
205	W. T. Clark	" " 35 ft. "	1.35	"	"	......	......

SPECIAL FIELD ANALYSES FOR ST. CLOUD.—*Continued.*

Number of Sample.	Name of Owner or Tenant.	Source.	Chlorine.	Nitrates.	Nitrites.	Ammonia	
						Free.	Albuminoid.
206	John Cooper	Dug well 80 ft. deep	1.89	Strong.	S. trace.		
207	Thos. Jones	" " 30 ft. "	5.31	"	"		
208	H. C. Waite	Drove " 100 ft. "	2.07	"	Distinct		
209	H. C. Ahlers	Dug "	6.48	"	S. trace.		
210	Mrs. Gilman	Drove " 80 ft. deep	3.51	"	"		
211	D. B. Searle	" " 80 to 100 ft. dp.	1.44	"	Marked		
212	Mrs. McKelvey	Dug " 100 ft. deep	3.69	"	Absent.		
213	J. B. Wildenborg	Drove " 24 ft. deep	.18	"	"	.001	.003
214	Boyd House	" " 60 ft. "	2.57	"	Distinct		
215	Dr. Dunn	" " 80 ft. "	4.59	"	Absent.	Trace	.009
216	James Robinson	" "	2.70	"	"		
217	F. Zabel	" " 16 ft. deep	2.70	"	"		
218	James Quinlivan	Dug "	2.97	"	"		
219	E. A. Steindorf	Drove " 18 ft. deep	2.61	"	S. trace.		
220	Sauer & Frankle	" " 18 ft. "	3.06	"	Absent.		
221	J. Remholz	Dug " 20 ft. "	3.06	"	"		
222	J. Miller	Drove "	1.89	"	Distinct		
223	Nick Lamhart	" " 25 ft. deep	2.07	"	Absent.		
224	J. F. Stevenson	" "	3.33	"	"		
225	Mrs. Bebensee	Dug " 18 ft. deep	2.34	"	Trace..		
226	Henry Kaiter	Drove " 14 ft. "	2.25	"	Absent.		
227	Kaiter & A. Larson	" " 14 ft. "	2.61	"	"		
228	E. W. Gruber	" " 36 ft. "	4.41	"	S. trace.		
229	Fred Zeotler	" " 50 ft. "	.36	Trace...	Absent.	.004	.002
230	L. J. Rochahl	Well 22 ft. deep	1.17	Strong.	S. trace.		
231	Aug. Ederbrock	Drove well	.40	"	Distinct		
232	J. W. Walter	Dug "	2.52	"	Marked		
233	Tileston mill	Spring	1.26	"	Absent.		
234	J. W. Webster	Drove well 20 ft. deep	.18	Distinct	"	.0005	.001
235	O. H. Larson	" " 16 ft. "	.58	Strong.	Marked		
236	Jno. Dougherty	Dug " 80 ft. "	1.35	"	"		
237	L. Ball	" " 20 ft. "	1.26	"	Absent.		
238	Geo. Morse	" " 20 ft. "	1.26	"	Distinct		
239	First Hill well	" " 40 ft. "	1.53	"	Trace..		
240	W. H. Thompson	" " 55 ft. "	5.49	"	"		
241	Mrs. Mellin	" "	1.80	"	Absent.		
242	Mrs. Tomlinson	" "	2.57	"	"		
243	Theo. Wing	Well 25 ft	1.53	"	Marked		
244	A. G. Whitney	Drove well 60 ft. deep	.72	Trace...	Absent.	.033	.008
245	H. Z. Mitchell	Well 90 ft. deep	.40	Strong.	"	.001	Trace
246	J. D. Thomas	Dug well 35 ft. deep	.22	Marked	"	.00	.002
247	Mrs. Atwood	Open " 45 ft. "	2.25	Strong.	Trace..		
248	T. J. Bonham	Dug " 40 ft. "	.99	Trace..	Absent.		
249	Mrs. Lyons	Drove " 26 ft. "	5.40+	Strong.	"		
250	Thos. Brown	" " 26 ft. "	1.17	"	"		
251	Old Marlott well	Dug well	.45	"	S. trace.	.006	.005
252	Mitchell, 5th Ave. and 3d St. So.	" "	1.35	"	Marked		
253	Lewis Clark	" "	.63	"	Absent.	.0005	.0004
254	Rob't Ashworth	Drove " 80 ft. deep	2.52	"	"		
255	Ashworth No. 2	Dug "	.67	"	Distinct		
256	Benson Bros	" " 8 ft. deep	5.4+	"	Marked		
257	Mrs. Hall	Drove " 18 ft. "	3.06	"	Trace...		
258	Hassel & Skumatz	" "	1.89	"	Marked		
259	A. F. Robertson	" " 17 ft. deep	5.4+	"	Absent.		
260	E. P. Long	" " 26 ft. "	3.60	"	S. trace.		
261	Jos. Beserius	Drove	1.71	"	Absent.		
262	Gammal & Meyer.	Dug well	1.30	"	Distinct		
263	Geo. Overbeck	Drove well 32 ft. deep	5.31	"	Absent.		
264	Geo. Overbeck, barn	" " 35 ft. "	1.17	"	"		
265	Jno. Kauffman	" "	3.78	"	S. trace.		
266	N. P. Kraemer	" " 30 ft. deep	1.17	"	Absent.		
267	L. J. Ahmann	" " 35 ft. "	1.08	"	Marked		
268	Barthelemen	" " 35 ft. "	1.26	"	Absent.		
269	Scott & Long	" "	.49	S. trace.	"	.0005	.0004
270	J. Little	" "	1.10	Strong.	"		
271	J. D. Hamlin	Dug well	1.17	"	"		
272	J. E. Haber	Drove 50 ft. deep	1.26	"	"		
273	McShane	Drove well	1.53	"	Trace...		
274	Harry Dyer	" " 50 ft. deep	1.53	"	Distinct		

SPECIAL FIELD ANALYSES FOR ST. CLOUD—*Continued.*

Number of Sample.	Name of Owner or Tenant.	Source.	Chlorine.	Nitrates.	Nitrites.	Ammonia.	
						Free.	Albuminoid.
275	Jno. Leison, Sr........	Drove well, 30 ft. deep...	2.61	Strong .	Distinct	......	......
276	Jno. Cooper............	" " 25 ft. " ...	1.17	S. trace.	Absent.	......	......
277	Geo. Spencer...........	" " 30 ft. " ...	.67	"	"	.029	.0055
278	Chas. A. Cooper........	" " 30 ft. " ...	4.32	Strong .	V. m'kd	......	......
279	C. A. Cooper...........	....	4.14	"	Marked	......	......
280	Harry Smith...........	Well 25 ft. deep..........	3.96	"	Trace...	......	......
281	Mrs. Honer............	Drove well..............	3.15	"	"	......	......
282	Wm. Kleppers..........	" "	5.40+	"	Distinct	......	......
283	Chas. Rechensperger..	" "	1.53	"	S. trace.	......	......
284	A. W. Raymond........	" "	2.25	"	"	......	......
285	C. J. Metzroth..........	Dug well................	.99	"	Marked	......	......
286	Hassel.................	Drove well..............	3.87	"	Trace...	......	......
287	Mr. Carl Kropp........	" "	.58	"	Absent.	......	......
288	Mrs. Jno. Kropp.......	" "	.58	"	S. trace.	......	......
289	L. Theilman (resid.)...	" "	.49	"	Marked	......	......
290	Frank Pohl...........	" " 18 ft. deep....	.27	S. trace.	Absent.	.0165	.0015
291	I. W. P. James..........	" " 18 ft. "	.49	Absent.	"	.0025	.001
292	M. Orth................	" " 30 ft. "	.63	Strong .	S. trace.	.003	.002
293	Otto Metroth.........	" "	.27	Marked	Absent.	.001	.003
294	Fred Reed.............	Dug " 36 ft. deep....	.67	Strong .	"	......	......
295	N. K. Whittemore.....	" " 30 ft. "	3.60+	V. str'g.	Distinct	......	......
296	Geo. R. Whitney......	" " 60 ft. "	1.53	Strong .	Marked	......	......
297	Helen McCarthy and Pfabb................	" "	2.52	"	Absent.	......	......
298	James Payden..........	Drove " 22 ft. deep....	1.17	"	Marked	......	......
299	H. S. Locke............	" "	.72	"	"	.006	.010
300	Carl and Jno. Larson..	" "	3.60+	"	Absent.	......	......
301	Washington school....	" "	1.53	"	"	......	......
302	Mr. Wikman...........	" " 22 ft. deep....	.18	"	"	.001	.004
303	W. H. Dudley..........	" " 10 ft. "	3.06	"	S. trace.	......	......
304	Wm. Friese............	" "	.90	"	Absent.	......	......
305	Theo. Fisher...........	" "	1.03	"	"	......	......
306	J. B. Barthelemy and Payden..............	Old open well, 25 ft. deep	2.34	"	Trace...	......	......
307	J. R. Sloan............	Drove well..............	.31	"	Absent.	.001	.002
308	E. S. Hill..............	" "	1.53	"	Marked	......	......
309	J. D. Thomas..........	" "	3.60+	"	Trace...	......	......
310	Central House Saloon.	" "	2.16	"	Marked	......	......
311	Journal press..........	" "	3.60+	"	Absent.	......	......
312	Baptist parsonage......	" "	3.60+	"	Marked	......	......
313	E. R. Bublitz...........	" "	1.48	"	Absent.	......	......
314	223 7th Ave. So.........	" "	1.89	Marked	"	......	......
315	Chas. Zapp.............	" "	.81	S. trace.	"	.020	.009
316	A. Anderson...........	Dug well 25 ft. deep......	2.34	Strong .	Trace...	......	......
317	Geo. Deering..........	Drove well..............	.40	"	Absent.	.002	.003
318	W. J. Huhn...........	" " 25 ft. deep....	2.00	"	Trace ..	......	......
319	Mrs. B. Hewen.........	" "	1.45	"	S. trace.	......	......
320	M. D. Miller...........	" " 21 ft. deep....	.35	"	Absent.	.001	.001
321	P. Herren..............	" "	.35	"	"	.001	.001
322	Peter Sieberger........	" "	.40	"	"	.005	.00
323	J. Lehmeier...........	" "	2.00	"	"	......	......
324	Jno. Winter...........	" "	1.70	"	"	......	......
325	Jacob Baron...........	" "	1.20	"	"	......	......
326	Mrs. Plaltes...........	" "	1.30	"	"	......	......
327	Stephen Schwartz.....	" "	1.10	"	"	......	......
328	Emil Hennemann......	" "	2.50	"	Trace...	....	......
329	L. Walbridge..........	" "	1.60	"	"	......	......
330	John Emmerick........	" "	.40	"	Absent.	.004	.004
331	Moth Leim.............	" "	.40	"	"	.00	.00
332	Barney Schmassen....	" "	.45	"	"	.00	.00
333	Nick Weber...........	" "	.65	"	"	.001	.001
334	Jno. Cronin............	" "	1.80	"	"	......	......
335	Jos. King..............	" "	1.80	"	"	......	......
336	Mrs. Kammermeyer...	" "	2.30	"	"	......	......
337	L. Lehmerer...........	" "	.75	"	"	.001	.001
338	Mrs. Anna Lahr.......	" "	.65	"	"	.001	.004
339	W. J. Huhn...........	River water filtered.....	.15	Distinct	"	.001	.001
340	John Schaefer.........	(2d sample) after cl'ng w	.90	Strong .	"	.001	.001
341	C. L. Atwood, farm....	Drove, 14 ft.............	.30	"	"	.001	.002
342	" "	" "	.15	"	"	.002	.003
343	Spring in meadow.....	....	.20	"	"	.001	.002

SPECIAL FIELD ANALYSES FOR ST. CLOUD—*Continued.*

Number of Sample.	Name of Owner or Tenant.	Source.	Chlorine.	Nitrates.	Nitrites.	Ammonia.	
						Free.	Albuminoid.
344	Chas. Allen	Drove well	.25	Trace	Absent.	.003	.001
345	E. E. Turpin		.20	Strong.	“	.002	.003
346	W. A. Gould	Drove well	.20	“	“	.001	.001
347	Geo. R. Fish	“ “	.60	“	“	.001	.002
348	H. G. Wire	“ “ 28 ft	.40	“	“	.00	.001
349	C. A. Bernick	“ “	.50	“	S. trace	.....	.....
350	N. P. Mertes	“ “	1.55	“	Absent.	.....	.....
351	J. A. Johnson	“ “	1.60	“	“	.....	.....
352	F. J. Havelock	Dug well	2.00	“	Trace	.....	.....
353	Jno. A. Zapp	Drove well, 40 ft	2.40	“	Absent.	.....	.....
354	Mrs. Spicer	Dug well	1.90	“	Distinct	.....	.....
355	Mich Leisen	Drove well, 28 ft	2.60	“	Absent.	.....	.....
356	G. W. Clune	“ “ 30 “	2.70	“	“	.....	.....
357	Mrs. Merz	“ “	1.75	“	“	.....	.....
358	Herbert Hansen	“ “ 16 ft	2.50	“	S. trace	.....	.....
359	Jno. Corling	“ “	.55	S. trace	Absent.	.022	.004
360	Nick Libert	“ “	.50	Trace	“	.025	.001
361	Theo. Bruener	“ “ 30 ft	2.80	Strong.	“	.....	.....
362	John Schumacher	“ “	.85	Marked	“	.....	.....
363	Golf Club	“ “	.10	Strong.	“	.00	.001
364	Empire Spring	Spring	5.1	“	“	.....	.....
365	Geo. Degree	Drove well	.55	“	“	.001	.001
366	Fritz Guy	“ “ 53 ft	.15	S. trace	“	.001	.001
367	A. C. Robertson	“ “ 30 “	.80	Absent.	“	.017	,001
368	Geo. Scherfenberg	“ “	.50	S. trace	“	.001	.001
369	P. J. Gruber	“ “ 35 ft	.70	Strong.	“	.001	.001
370	Geo. Maroon	“ “	1.30	“	“	.....	.....
371	H. T. Moorin	“ “	1.10	S. trace	“	.....	.....
372	Jno. Wastrom	“ “ 25 ft	.35	“	“	.001	.001
373	Mrs. Staples	Dug well	1.15	Strong.	“	.....	.....
374	Moss	Drove well	.85	“	“	.001	.001
375	Mrs. Bowing	“ “	.90	“	“	.001	.002
376	Wm. Patteson	“ “	.80	“	“	.001	.002
377	Jno. Bernauer	River ice, melted	.10	Trace	“	.001	.003
378	A. C. Wyman	Drove well, 28 ft	2.10	Strong.	“	.....	.....
379	Raymond	Dug well, 25 ft	3.00	“	“	.....	.....
380	Albrecht, Sr.	Drove well, 28 ft	1.50	“	“	.....	.....
381	S. P. Howard	Dug well	1.30	“	“	.....	.....
382	C. A. Bach	Drove well	1.15	“	“	.....	.....
383	Rev. G. Britzius	“ “	1.70	“	“	.....	.....
384	Jno. Majeon	“ “	3.15	“	“	.....	.....
385	Frank Storms	Dug well	2.80	“	“	.....	.....
386	M. Lansted	Drove well, 20 ft	.75	“	“	.....	.....
387	Nick Scherer	“ “	.20	Trace	“	.001	.002
388	P. Zierlen	“ “	.85	Strong.	“	.001	.001
389	Jno. Quinlivan	“ “	.90	“	“	.001	.002
390	Emil Puff	“ “	1.10	“	“	.....	.....
391	C. Trizinski	“ “	1.10	“	“	.....	.....
392	Jos. Schellinger	“ “	3.30	“	“	.....	.....
393	H. Collignon	Dug well, 24 ft. deep,	1.50	“	“	.....	.....
394	Wm. Ernest	Drove well, 24 ft. deep	1.30	“	“	.....	.....
395	And. J. Gruber	“ “ 20 “	.45	“	“	.003	.002
396	Mr. Ahlers	“ “	.50	“	“	.004	.003
397	J. O. McConnell	Dug well, 20 ft. deep	.30	“	“	.00	.001
398	Lake George	Lake	.80	Trace	“	.00	.001
399	Hospital (inside)	Drove well, 16 ft. deep	1.90	Strong.	Distinct	.....	.....
400	Hospital (outside)	“ “ 20 “	1.90	“	Absent.	.....	.....
401	Boll	“ “	2.00+	“	“	.....	.....
402	A. Fritz	“ “ 20 ft. deep	1.50	“	“	.....	.....
403	Jno. Lynch	“ “	.55	“	“	.00	.001
404	Ben Kost	“ “ 30 ft. deep	1.10	“	“	.....	.....
405	Dan Quinlivan	“ “ 60 “	2.00+	“	“	.....	.....
406	C. F. Ladner	“ “	2.00+	“	“	.....	.....
407	H. P. Burnett	Open well, 43 ft. deep	.70	S. trace	“	.001	.002
408	C. A. Gilman	Dug-Driven well, 40 ft	1.60	Strong.	“	.....	.....
409	Carl Lathart	Dug well, 36 ft	2.00	Distinct	“	.....	.....
410	Geo. Reis	“ “	.30	Marked	“	.00	.001
411	Jno. Crever	Drove well	.90	Strong.	“	.00	.00
412	Frank Zins	“ “	2.00	“	Distinct	.....	.....
413	Esederle	“ “	2.00+	“	Absent.	.....	.....
414	D. T. Calhoun	“ “ 26 ft. deep	1.40	“	S. trace	.....	.....

SPECIAL FIELD ANALYSES FOR ST. CLOUD—*Continued.*

Number of Sample.	Name of Owner or Tenant.	Source.	Chlorine.	Nitrates.	Nitrites.	Ammonia.	
						Free.	Albuminoid.
415	G. N. Freight Depot...	Drove well...............	2.00	Strong .	Absent.	......	......
416	Chris Schmitt..........	" "	1.50	"	"	......	......
417	Lunperich.............	" "	1.60	"	"	......	......
418	Jos. Kowalkowski.....	" "	1.15	"	"	......	......
419	J. Prondzniski	" "	1.30	"	Trace...	......	......
420	Jacob Frassen..........	" "	.45	"	Absent.	.002	.00
421	M. P. Mieson...........	Dug well, 50 ft. deep.....	2.20	"	"	......	......
422	M. Wecrens............	River ice..................	.07	Trace ..	"	.002	.00
423	Name not ascertained.	Drove well...............	.35	Strong..	S. trace	.018	.006
424	W. Neumeier...........	Spring.....	.50	V. str'g	Absent.	.001	.001
425	Quinlivan	Lithia Spring............	.10	Marked	"	.00	.00
426	Gus Koch	Drove well...............	.40	Strong..	"	.001	.001
427	Nafzigger..............	Drove well, 55 ft. deep..	1.90	"	"	......	......
428	J. J. Hicks.............	Dug well.................	.80	"	"	.001	.001
429	Michalson	Open well, 40 ft. deep....	.25	"	"	.001	.002
430	Martin Connally.......	Dug " 60 " ...	1.30	"	"	.00	.00
431	Gust Larson	" " 50 " ...	.30	"	"	.001	.003
432	A. D. Doane............	Drove well...............	2.00+	"	"	......	......
433	Jacke Northsted.......	Dug well.................	.50	"	"	.004	.006
434	O. F. Doyle.............	" "	.30	"	"	.002	.001
435	Mulligan	" " 60 ft. deep......	1.20	"	Trace ..	.00	.010
436	Peter Clarity..........	" " 57 "	.35	"	Absent.	.001	.001
437	Sam Meagher..........	Drove well...............	.35	"	"	.002	.001
438	E. C. Schultz...........	Dug well, 52 ft. deep.....	.35	"	"	.001	.002
439	A. N. Pelton............	Drove " 70 ft. deep..	.55	"	"	.00	.00
440	Frank Shero...........	Tubular well, 57 ft. deep.	1.00	"	"	.00	.00
441	Frank Beaudreau......	Dug " 52 "	2.00+	"	"	......	......
442	David McCarthy	" " 50 "	2.00+	"	"	.....	......
443	Warner	Well, 56 ft. deep	2.00+	"	"	......	...
444	Geo. McCullam........	Dug well, 50 ft. deep....	2.00+	"	Trace...	......	......
445	W. W. Murphy	" " 50 "	2.00+	"	Absent.	......	......
446	Freeburg...............	Open " 20 "	2.00+	"	"	......	......
447	A. Istrup...............	Dug " 60 "	2.00+	"	"	......	......
448	W. Hetherington......	Drove well......	2.00+	"	S. trace	......	......
449	A. G. Whitney.........	" "	1.25	Marked	Absent.	......	......
450	Mrs. J. Gates..........	" "	.80	Strong..	"	.00	.00
451	Chas. McLeod..........	" "	.60	"	"	.002	.00
452	Grand Union Hotel....	" "	2.00	"	"	......	......
453	Mrs. Alexander........	" "	.15	"	"	.004	.002
454	†Geo. F. Wahl.........	" "	....	....	....	......	......
455	A. M. Summers........	" "	.90	Strong..	Absent.	......	......
456	H. R. Neide......	....	.80	Distinct	"	......	......
457	B. Mueller..............	Drove well, 25 feet deep.	.90	Strong..	"	......	......
458	Jno. Heinan	Dug well.................	2.00	....	Strong .	......	......
459	Jno. Zurtin	Drove well...............	1.00	Strong..	Absent..	......	......
460	Jno. Bernuck..........	" "	1.45	....	"	......	......
461	Mr. McQueen..........	" " 18 feet deep..	2.00	....	"	......	......
462	Mr. Griebler...........	" " 25 " " .	1.30	....	"	......	......
463	J. D. Sullivan..........	" "	.80	Strong..	"	......	......
464	Ed. Hart................	" "	2.00+	....	"	......	......
465	H. P. Bennett..........	....	1.80	....	"	......	......
466	Mr. Nurrenberg.......	....	.90	Strong..	S. trace	......	......
467	Jno. Coates.......	....	.40	"	Absent..	.002	.003
468	W. Ryan................	....	2.00+	....	"	......	......
469	Mr. Gans	....	.75	Strong..	"	......	......
470	Mr. Osgood............	....	1.60	....	"	......	......
471	Mr. Stafford...........	....	2.00	....	"	......	......
472	Chas. Schmitt.........	....	.10	....	"	......	......
473	Chas. Schmitt's barn..	....	2.00+	....	"	......	......
474	Mr. Francis............	....	2.00+	....	"	......	......
475	Mr. Freeman, No. 1....	....	.60	S. trace.	"	......	......
476	Mr. Freeman, No. 2....	....	2.00	....	"	......	......
477	J. E. Oberg........	....	.65	S. trace.	"	......	......
478	Mr. Sinclair............	....	.30	....	"	.001	.003
479	W. F. Webster.........	....	.80	Strong..	....	......	......
480	East Central...........	....	2.00+	....	Distinct	......	......
481	Hagemann.............	....	.95	....	Absent..	......	......
482	Harkness	....	2.00+	....	"	......	......
483	Jno. Webster..........	....	2.00+	....	"	......	......
484	W. L. Beebe............	Cistern...................	.09	Trace .	"	.019	.008
485	D. A. Perkins..........	....	1.98	Strong..	Distinct	......	......

† Bottle broken.

SPECIAL FIELD ANALYSES FOR ST. CLOUD—*Continued.*

Number of Sample.	Name of Owner or Tenant.	Source.	Chlorine.	Nitrates.	Nitrites.	Ammonia. Free.	Ammonia. Albuminoid.
486	Dr. Beebe	Melted ice	.09	Distinct.	Absent.	.004	.003
487	....	Fountain spring	.67	S. trace	"	.005	.001
488	Judge Collins	....	2.97	Strong..	Distinct	......	......
489	Alva Eastman	....	1.35	....	Absent.	......	......
490	Dr. Beebe	Upper spring	.09	Distinct	"	.00	.001
491	"	Lower spring	1.53	Strong..	S. trace	......	......
492	J. A. McDonald	....	.77	"	Absent.	......	......
493	J. F. Wray	....	1.50	"	"	......	......
494	T. E. Morgan	....	2.80	"	"	......	......
495	W. J. Holes	....	.80	"	"	.00	.001
496	G. Gehrenbeck	....	2.10	"	"	......	......
497	G. Fowler	....	.70	Trace ..	"	.001	.001
498	....	Molitor old house	.75	Strong..	"	.001	.001
499	....	Molitor new house	2.00 +	"	"	......	......
500	Wm. Powell	....	1.40	"	S. trace	......	......
501	J. Smith	....	2.10	"	"	......	......

LABORATORY ANALYSES.

The routine laboratory analyses covered by this report were largely of suspected water and ice supplies sent in by local health officers, and in the majority of cases the chemical analyses were unfavorable. With reference to ice supplies, we have found by experience that many polluted waters will yield a passable ice analysis. The freezing process, as is well known, expels most of the solid ingredients, upon which the chemical analysis rests. Ice analysis is, therefore, untrustworthy in many instances, and the water itself should be examined.

Many of the wells mentioned in this series were supplying families in which typhoid fever was prevalent, and their analyses point directly to the water as a distributing center. Some of these typhoid cases are mentioned, especially under earlier numbers; most of them are not because it is merely a repetition of what is already so well known, that bad water and typhoid fever go hand in hand.

Going directly to the analyses, we will start with No. 711, which represents the average bored well in a closely settled district. It passes through some 38 feet of loam and clay, and said clay is supposed to shield it from all pollution. The chemical analysis and four cases of typhoid in the family prove otherwise. No. 712 is a similar water.

The analysis of the school well at SHERBURN (No. 713) gave suspicious data, and we advised a second examination in a few weeks. Analyses Nos. 714-17 are of SPARTA samples. They are all shallow wells, in the sand, with varied contamination around them. Thirty-three cases of typhoid were reported from among the users at the time of the analysis. The same kind of water is shown in analysis No. 718, and the same disease was being treated.

Of the six samples of shallow wells sent in by the FAYAL board of health, four were condemned at once and two considered suspicious, and second samples asked for (Nos. 723 and 725). No. 726 represents a fine flowing well from MANKATO. It was sent

to obtain a comparison with the city wells. Its geological data were as follows:

Blue clay	40 ft.
Quicksand	30 "
Blue clay	25 "
Sandstone	470 "

No. 727, also from Mankato, is a common dug well, with typhoid in the family.

The McKINLEY well, represented by No. 728, is similar water. No. 729, however, represents water from one of the test pits at McKinley, and is a much better quality. A second sample of this water is represented by No. 738, which analysis was sufficiently good to pass.

The series of waters from EVELETH is represented by Nos. 730-35. Of these Nos. 730, 732 and 734 were condemned, the other two passed. No. 730 is a private well, with seven cases of typhoid in the family. The village supply was formed by a mixture of waters from the Spruce mine sump (No. 731), the Fayal mine sump (No. 733), and from a dug well 30 feet deep (No. 734). This last was dug on an old camp site, and considerable refuse was removed from around it. The two mine sumps yielded good analyses; the dug well was condemned (No. 734). There were 50 cases of typhoid in Eveleth.

No. 735 represents the small lake supplying SPARTA. A small creek carrying sewage empties near the intake pipe, and 100 cases of typhoid were in the village. No. 736 came from the Fabiola hospital at Fayal. The analysis is condemnatory. No. 737 represents a dug well from McKinley.

The Owatonna samples, represented by Nos. 739-40, came from the state school at the time of the appearance of typhoid fever. The analyses condemn the waters. Nos. 741-44 represent contaminated waters in MINNEAPOLIS, MILAN and ELBOW LAKE.

Nos. 745-47 represent samples from the state hospital at ROCHESTER, and from the Zumbro river. The analyses have diminished value, because the water stood some weeks in the office of the local officer of health before shipment. Sample bottles were sent, Nov. 30, 1900, for fresh specimens, but have not been returned (Nov. 15, 1901). Fresh samples, however, were taken during the past summer's survey (L. A. Nos. 812 and 814-15).

The CHATFIELD water and ice supplies have been previously considered. The wells at BRAINERD and SACRED HEART, represented by Nos. 750-52, are polluted surface waters, and the one from FRANKLIN was considered suspicious (No. 753). The two samples (Nos. 754-55) are from a DAKOTA spring, and were analyzed for Prof. Flather, of the University. These samples were a week old, and fresh ones were requested. The O'Connor spring at SACRED HEART is shown under No. 756. Its analysis is passable, but by no means the best.

The 203-foot well at CROOKSTON, represented by No. 757, yields a high chlorine (8.5), but we did not condemn it because of the strong probability that this is a natural chlorine. We judge so from the United States reports on the Red River valley, which give several high chlorine waters. The MADELIA and WABASHA samples, shown under Nos. 758-60, are common surface wells, subject to organic infiltration. Of the three MILAN samples, represented by Nos. 761-63, one was passed (No. 761).

The village supply of LUVERNE was referred to in the 18th biennial report. Another analysis of this water is shown under No. 764. It was again condemned. No. 765 represents a deep drilled village well at HAYFIELD. It passes through 118 feet of sand and clay, and yields a fairly good analysis. Nos. 766-69 represent certain wells and cisterns at OWATONNA public school, taken during a siege of typhoid fever. The cisterns were condemned outright, and we requested fresh samples of the wells and tank. These were not sent. Analyses Nos. 770-71 are of the spring waters referred to under Nos. 754-55, and present considerably better data.

The ice supply of PIPESTONE is taken from two little lakes nestling in the solid rock, and far removed from pollution. Their analyses are shown under Nos. 772 and 773. The RUSH CITY school well and analysis is shown under No. 774. No other data were given, but its albuminoid ammonia condemns it under any circumstances. Two more of the polluted shallow wells at WABASHA are shown under Nos. 775 and 776. No. 777 is a FERGUS FALLS well, showing poor analysis, and No. 778 is another examination of the LUVERNE village well. Big Lake at MONTICELLO yields a very good lake analysis, as shown under No. 779. It would make an excellent source of ice supply. Ice water from the melted ice taken out of ELBOW LAKE gave analysis No. 780. A sample of the ice itself was requested.

No. 781 represents a Minneapolis well, driven eight feet in the gravel, and within 50 feet of an out-house. It supplies a large number of mill hands, and was condemned. Nos. 782-83 are shallow wells from DODGE CENTER and REDWOOD FALLS. No. 785 represents the village supply at OLIVIA. It is a drilled well, 379 feet deep; through yellow clay 36 feet, blue clay 304 feet, gumbo 3 feet, shale 36 feet. There are two cess-pools about 200 feet from the well. We advised making a salt test of the two cess-pools, and sending the samples to the laboratory; no answer was returned.

The 17-foot dug well at WADENA, represented by No. 786, was condemned. The REDWOOD well, previously shown under No. 783, was again analyzed, as shown under No. 788. The varied data gave strong evidence of pollution, which presumably distributed typhoid to its users. Nos. 789-90 are analyses of shallow wells in WADENA and CANBY. Tokna lake at GRACEVILLE is an example of the kind of ice sold for domestic use (No. 791). The water stands in a little depression in the drift. Its depth is two feet, and it is rank with vegetation. It has no outlet, nor any inlet, save that formed by the sewage from Graceville. Nos. 793-94 are polluted waters from NEW BRIGHTON and BRAINERD. Nos. 794-96 are analyses of the polluted Rum river, taken at ANOKA. Nos. 797-99 are analyses of polluted wells from TRACY, MINNEAPOLIS and HERMON.

The series of analyses given of the Indian Medical spring waters were taken to determine the purity of this water and the sanitary conditions of its transportation from Elk river. (See Nos. 800-06.) The previous analysis of some of the water taken from the distributing tank wagon was bad, but this series gave evidence that the poor quality of the first samples was due to accidental contamination. The last three samples were taken at different dates from the wagon tank. These analyses were made because the Indian Medical spring water was supplying the University.

Another Rum river analysis is shown under No. 807. The three samples from GARVIN (Nos. 808-11) were sent in small bottles, which accounts for the partial analysis. At ROCHESTER samples of the city and state hospital wells of Bear and Cascade creeks and of the Zumbro river were taken as part of the field survey (Nos. 812-16). The WADENA spring, shown under analysis No. 817, yields good chemical data. The MILAN well

(No. 818) is dug 60 and bored 15 feet in blue clay, sand and gravel. No sources of pollution were stated, but its analysis was suspicious. Nos. 819-21 represent certain MONTEVIDEO waters, Of them, the most important is No. 819, the spring of the bottling company. This water was sold for drinking purposes, whereas the chemical data show it unfit for domestic use. The other waters were not much better. The GARVIN waters (No. 822-23) are both from wells of doubtful purity, supplying typhoid stricken families. The CHIPPEWA spring water was examined as a means of comparison with our Minnesota springs. It would pass as a fairly good specimen, but we have more organically pure waters in our own state. The two shallow wells from MILAN, represented by Nos. 825-26, were both condemned. The GRAND RAPIDS spring (No. 827) yields a fair quality of water. The EDEN VALLEY sample (No. 828) was condemned. Analysis No. 829 is of a spring intended for public use at GRANITE FALLS. We could not, however, recommend it. A fairly good lake water has, however, been secured recently. This lake is mentioned in the 18th biennial report, F. A. No. 799. Another good spring water is shown in the PARK RAPIDS analysis, represented by No. 830. Nos. 831-32 are polluted waters in PRINCETON and EVELETH.

Lake McKusick, represented by No. 833, was sampled at the STILLWATER intake pipe. The lake is a small elongated body of water supporting considerable vegetation. The end from which the sample was taken is partly surrounded by the city of Stillwater, and necessarily receives drainage from the out-houses, which are in evidence. With lakes of this kind it is absolutely necessary to depend largely on a study of the environment, because the condemning data of the analysis are undoubtedly due, in part, to the vegetation, and it is impossible to draw a line between, for example, albuminoid ammonia due to sewage, and albuminoid ammonia due to vegetation. The following opinion was sent: "I would advise against using this water as public supply. The analysis shows excess of both ammonias, and, moreover, the environment is not good."

Nos. 834-840 represent more or less polluted waters from OLIVIA, KILKENNY and NORTH MANKATO. The MANKATO wells we collected ourselves. Of the ST. CLOUD series (Nos. 840-45) the first three were taken with a view of using the water as a city supply. Their analyses were, on the whole, good, but the one designated "the upper levee" well yielded a high

chlorine. This was a flowing well on the river bank, favorably situated as to environment, and yielding an otherwise excellent analysis. A study of the surrounding country gave us six other waters yielding a similar chlorine, but not so good an organic analysis. A second analysis of the upper levee well, made five weeks later, yielded practically the same data as the first. The well was therefore passed as organically good, and will probably be used as part of the city supply. The two St. Cloud wells (Nos. 843-44) represent suspicious waters in the city. No. 845 was taken in the outskirts. It is better, but not free from suspicion, by reason of its nitrates.

The KENYON village well, the village tap and the Commercial hotel wells all yield poor chemical data. These wells were examined during the summer, and Nos. 846-49 represent second samples of each of them, and the first sample of a private well. No. 850 represents a spring sample from Faribault, and forms the last of the samples sent in for analyses. Nos. 851-923 represent samples collected during the field survey and examined in the laboratory. They are referred to under headings "Report by Counties" or "Chlorine," or both.

Biwabik—The village of Biwabik, through Dr. Bray, sent in a sample of its public well for examination Sept. 21, 1901. A second sample was requested, and sent Oct. 10, 1901. The two analyses showed considerable variation, the last especially giving evidence of pollution, and the well was condemned (Nos. 921 and 930). No. 989 represents another Biwabik well, 190 feet deep. When the statement of such a depth is made, we naturally infer that the water comes from 190 feet, but this well was dug 90 feet and then drilled 100 feet. The water, however, stands 20 feet deep in the dug well, and its surface infiltration is shown by the analysis. These samples were sent on account of the typhoid prevailing in the village.

Eveleth—Samples No. 922-3 were sent in by Dr. Harwood of Eveleth, and represent, respectively, a well and its tank water. The slight increase in albuminoid ammonia on the tank analysis evidenced some collected debris.

Claremont—Two samples of bored well water were sent by Dr. Way of Claremont, on account of certain cases of typhoid. Both analyses were considered suspicious.

Wabasha—Nos. 926-28 represent three driven well samples, sent in by Dr. Milligan of Wabasha, also on account of certain typhoid cases. The analyses bore out the doctor's suspicions.

Wabasso—No. 929 represents a similar well from Wabasso, sent in by Dr. Lucas.

St. Louis Park—Five samples of driven well water were sent in by Mr. W. C. Otts of St. Louis Park, on account of typhoid fever here also. All the wells yielded suspicious or condemning data (Nos. 831-35).

Lakeville—The village of Lakeville sent in four samples of dug and driven well water, represented by Nos. 936-39. No particular reason was assigned, but all the wells yielded condemning data.

Lake Minnetonka—A sample of water from a driven well near Lake Minnetonka was brought in by Dr. Dickinson. The water supplied several cottages, and was considered good.

Hopkins—An examination of a dug well sample was made for Mr. Lindsley, a medical student. The data, as given under No. 941, are quite bad, and help to account for the typhoid in his family.

Springfield—No. 942 represents a bored well sample, sent in by Mr. Leacheman of Springfield. It was not considered fit for domestic use.

Frazee—No. 966 represents a poor quality of dug well water from Frazee, sent in by Dr. I. S. Jones. This well was used as the school supply.

Albert Lea—Nos. 949-50 represent, respectively, the new 450-foot city well at Albert Lea and the city settling tank. The samples were sent in by Dr. Burton, and the analyses were considered good for deep well water.

Mankato and North Mankato—Samples Nos. 967 and 985 were sent in, respectively, by Dr. Anderson of North Mankato, and by Dr. Holbrook of Mankato. They both represent shallow wells, subject to surface infiltration.

Montevideo—The Montevideo samples were sent in by the village board of health. They are Nos. 968-69, and represent Carleton lake at two depths. The village is considering this lake as

a possible public supply. The first analysis of this water was made as part of the survey of 1900. (See field analysis No. 799.)

Minneapolis—The only important Minneapolis analysis was that of an excellent flowing well located at the government dam. The water comes from a depth of 507 feet, and is considerably used by the working force and the adjacent dwellings. Its analysis is shown under No. 1027. Nos. 978 and 1122 represent two springs, of which the history was not given. Nos. 1127-28 are analyses of two dug wells, used by employes of the State University.

Morton—Three samples of water were forwarded by Dr. Penhall of Morton, on account of typhoid fever. They are represented by Nos. 979, 986-87, and all yielded suspicious or condemning data.

Franklin—No. 982 represents a sample sent in by Dr. Cole, and taken from the tank of the village water works. No. 981 represents an 80-foot bored well used as a domestic supply. The stratification of this well was given as follows: Loam three feet, yellow clay 35 feet, alternating sand and gravel 42 feet.

Luverne—No. 980 represents a dug well sample, sent in by Dr. Guthrie of Luverne, on account of certain typhoid cases.

Dexter—For the same reason Dr. Scholter of Dexter forwarded No. 983, which represents a bored well 150 feet deep. The well has an iron casing, and passes through the following strata: Loam 4 feet, yellow clay 25 feet, blue clay 114 feet, rock seven feet. There is a vault within 55 feet, and the analysis evidenced pollution. Probably the sewage seeps down outside the pipe to the water strata. Both wells were condemned.

Clinton—No. 988 represents the school well at the village of Clinton. The sample was forwarded by Mr. J. B. Babcock, and was not considered passable.

Madelia—Two samples of bored well water were forwarded by Dr. McCarthy of Madelia. They are both domestic supplies, and are represented by Nos. 1002 and 1059. Typhoid existed in one of the families, and the data of both wells poor.

Adams—Two samples of well water were sent in by Dr. Knight of Adams. Blanks were sent for data, but were not returned, and no report was made.

Kenyon—Dr. Gates of Kenyon sent in two samples of well water. No. 1005 represents a 75-foot drilled well, and No. 1006 a 26-foot dug well. The latter was condemned.

Pipestone—In the report of the water survey of Pipestone county (biennial report 1900-1, page 193) we stated that the village of Pipestone had begun to dig certain wells for a public supply. We further stated that the location was unsanitary, and we protested against it, both in said report and to the local health officer personally. We further made personal examination of another large field belonging to the town, and advised placing the wells there. In spite of our protest, and that of Dr. Taylor, H. O., the work was continued, and the wells put in use.

They are dug wells, 16 feet deep in the sand and clay, with a barn some 50 feet distant. The drainage from this barn passes directly towards the wells.

Nov. 22, 1901, a sample of the mixed supply of these three dug wells was sent in by Dr. Jenks, and on January 27th a second sample from the same wells. The analyses are given under Nos. 1007 and 1029, and speak for themselves.

This is an example of absolute disregard of all sanitary conditions, as well as of our advice. The people now drink foul, instead of pure, water. No. 1111 represents a common domestic supply, and No. 1110 represents the ice supply of Pipestone.

Sleepy Eye—The village well at Sleepy Eye has been condemned already on two occasions as per my annual report for year ending Sept. 20, 1901. No. 1009, sent in by Dr. Wellcome, Jr., represents another sample from this same well, which, I understand, is yet in use. No. 1008 represents the school well, which has also been examined several times. No. 1031 represents a 50-foot bored well sent in by Dr. Strickler. It is a poor water, but serves to emphasize the pollution of the village well, as shown by the chlorine.

Sanborn—A specimen of the village supply was sent in by Dr. Bennett of Sanborn. The well is driven 300 feet, and the water pumped directly into a cistern, from which the sample was taken. Its analysis, shown under No. 1011, was considered good for a deep well water. No. 1010 represents a 32-foot bored well, with adjacent sources of pollution.

Claremont—Five shallow well samples were sent in by Mr. Wm. Doepping of Claremont on account of the typhoid prevailing in that village. The analyses are shown under Nos. 1012-16, and not any of them were considered passable.

Brainerd—This city is supplied from the Mississippi river. The water is pumped through a sand alum force filter, erected some 17 years ago. Said filter is 17 feet in diameter and five feet deep. It is also provided with one foot of coke. The engineer stated that the filter was cleaned daily by reversing the pumps, and gave its capacity as 600,000 gallons per day.

At the request of Dr. Thabes, H. O., I made a personal inspection of conditions at certain points above the intake pipe; also of the filter, etc. The following samples were also taken: (1) Rice lake, a body of water formed chiefly by the back up of the river above the dam; (2) outlet of Rice lake; (3) at dam of the electric company; (4) intake pipe; (5) filtered water; (6) city tap at Dunn's drug store. Their analyses are shown under Nos. 1017-22. All the samples were condemned Dec. 11, 1901. Analysis of the filtered water was somewhat better, but by no means passable. The tap analysis evidenced a mixture of filtered and unfiltered water. No final action has as yet been taken on this condemnation save that of nature, which supported the analyses by an outbreak of typhoid fever numbering 50 victims in a population of 7,500. The outbreak began in January, 1902, less than a month after the water was condemned.

New Ulm—Two samples of river water, one out of the Minnesota, three miles above New Ulm, and one of the Cottonwood river, were sent in by Dr. Reineke. They are represented by Nos. 1023-24, and yield poor river analyses.

Heron Lake—Two samples of well water were sent in by Dr. Kellam, and one by Mr. O. C. Ochs of Heron Lake. They are represented by Nos. 1025, 1066 and 1091, and all yielded poor analyses.

Oakland—A sample of water from a 100-foot tubular well was sent in by Mr. F. Morgan on Jan. 24, 1902. There was typhoid in the family, and the water yielded analyses No. 1028. A second examination was made February 27th, giving analysis No. 1042. The following opinion was sent: "Chemical analysis classes this water as suspicious. I should advise against using it for domestic purposes."

Edina Mills—Sample No. 1030 represents Minnehaha creek at the mill dam of Edina. This sample was personally taken by cutting through the ice, with the assistance of Mr. M. L. Larsen, of the Edina Board of Health. The water was filthy.looking,.and.there was a noctic odor of hydrogen sulphide from the decaying organic matter. This analysis was the first step with reference to the alleged pollution of Minnehaha creek by the Minnesota sugar factory. The data are given under No. 1030.

Farmington—Sample No. 1032 was sent in by Mr. T. H. Lintner, but no data were sent, and the analysis was not reported. No. 1041 represents a tubular well, 40 feet deep, with passable environment. Its analysis was considered good.

Owatonna—Nos. 1076-77 purported to represent samples from the Owatonna reservoir and tap, but the analyses were very different, especially the albummoid ammonias; moreover, no other data were sent, and no opinion was given. No. 1035 represents the 20-foot dug well at the Owatonna hospital. The cesspool is within 60 feet, and the analysis condemned the water. No. 1036 was sent as a sample of the 80-foot Owatonna artesian. The following opinion was given: "These data are entirely different from the chemical analysis of the deep well made during the chlorine survey. If this sample was taken from the unmixed water of the Owatonna city artesian, some source of pollution has reached that well. The analysis, however, would indicate surface water."

Le Sueur—No. 1037 represents a 60-foot open well sample sent in by Dr. Le Clerc. There was a cesspool at 50 feet, and typhoid in the family.

Russell—Nos. 1038-40 represent samples sent in by private citizens of Russell. No data, however, were sent, and no opinion was given. Certain spring samples were sent by Dr. Weyrens, with the object of using them for a village supply. No. 1055 represents those taken one mile above Russell. The analysis was barely passable. The other springs were taken three miles below the village, and yielded better results. The Redwood river at Russell is represented by No. 1057.

Bruno—No. 1043 represents an excellent spring sample sent in from Bruno by a private citizen.

Long Prairie—The village of Long Prairie sent in a number of specimens with the object of selecting a public supply. They are

represented by Nos. 1044-48; also by No. 1065, sent by Dr. Christie, president of the village council, and No. 1072, sent by Dr. Van Valkenburg, the local officer of health.

The town well (No. 1048) was condemned, and none of the other wells considered passable.

Lake Charlotte, represented by No. 1044, was the only fairly passable water on the list.

Argyle—Dr. Belcourt of Argyle forwarded samples of the east and west village wells (Nos. 1049-50). The west well was condemned at once, and the following opinion sent with reference to the east well: "This analysis is very much better than that of the west well, yet I hesitate to pass the water by reason of the high chlorine and the presence of nitrates. We are not yet familiar with the normal chlorine of Marshall county, therefore cannot say whether or not the 9.5 represent pollution or natural salt. I can give you a final opinion only after examining a number of waters of similar depth and environment. Should you care to assist me in this matter, I will forward a container with as many bottles as you say."

In answer to this opinion Dr. Belcourt collected and forwarded samples from nine Argyle wells, including a second sample from the east public well. The analyses are given under Nos. 1082-90. The following opinion wtih reference to the east public well was then sent: "This is by far the best water of the entire series you have sent me. I should advise you to keep watch of it by sending in an occasional specimen of it for analysis. A dug well in a town is always liable to pollution, unless exceptionally located as to environment and drainage."

Winthrop, Blakeley and Hammond—Samples Nos. 1051-54 and 1058 represent shallow wells from these villages. They all show more or less contamination. The Winthrop sample was from the school well. The Blakeley samples were sent on account of typhoid fever.

Warren—Nos. 1067-71 represent flowing wells from Warren, collected by Mr. Taralseth. Their chlorine are all high, and show great variation. It is difficult to form a true judgment of the sanitary quality of these waters until after the chemical survey has determined the normal chlorine.

Buhl—No. 1075 represents the village supply at Buhl, collected by Dr. Shaw. The well is dug 28 feet in clay and gravel, with a vault within 20 feet.

Red Wing—Samples Nos. 1078-81 were collected at Red Wing by Dr. Wesbrook. The first three represent the training school well, the tank and a tap sample. The analyses give evidence of a dirty tank and mains. The last (No. 1081) was taken from the Mississippi river, and demonstrates the fact that a well, dug on a river bank, does not necessarily fill from the river seepage.

Kilkenny—Nos. 1102-4 represent the shallow wells from Kilkenny. Samples were sent by Dr. MacDonald, and all evidenced more or less pollution.

Shady Oak Lake—The Shady Oak water and ice samples (Nos. 1105-06) were collected with a view to the availability of this lake for a Minneapolis ice supply.

Montevideo—The Montevideo sample (No. 1109), sent by Dr. Henderson, represents a common shallow well.

Twin Valley—No. 1112 represents the well on Mr. Bunhart's farm, near Twin Valley. There were seven typhoid patients, who had used this water. The sample was sent by Dr. Larson.

Rochester—Nos. 1115-17 represent three samples sent by Dr. Mosse of Rochester. They were taken from three driven wells of the same depth, and presumably drawing water from the same stratum, as their analyses were quite similar.

Halstad—No. 1121 represents a deep well sample from Halstad, sent by Dr. Bennett. It was considered suspicious.

Jackson—The Jackson sample, sent by Dr. Maitland, represents a common dug well (No. 1129).

Fergus Falls—On May 20, 1902, the local health officer, Dr. A. B. Cole, requested a personal inspection of a certain pollution which threatened the purity of the city's water supply, and which was outside of his jurisdiction. The following conditions were noted. The Ottertail river supplies the city. Two and one-half miles above the intake pipe we found six (6) cases of typhoid in a small shanty, situated directly on the river bank. There was no outhouse on the premises, and all refuse, night soil, etc., was taken to the river, or emptied on its banks. Other filthy conditions were

in evidence, to wit: (1) A barn with manure two feet thick on the floor, and a manure pile six feet high outside, with rotting manure covering an area of many square feet in the yard; (2) the decaying body of a calf; (3) a hog run; (4) a quantity of old clothing, bed covers and straw ticks about the premises. All of these were so situated on the steep river bank that a constant drainage was passing into the water. This was further evidenced by chemical analyses of samples taken, (1) above this place; (2) just below; (3) at the intake pipe; (4) at the hotel tap.

We instructed the owner to immediately erect an out-house at a spot we selected, and to thoroughly clean up his premises. These directions, we understand, were complied with. A notice to boil the water was put in the Fergus Falls paper.

A second chemical examination of the Ottertail river water at Fergus Falls was made June 13, 1902. The stream yet evidenced some pollution, as shown in its analysis (No. 1132.) June 29, 1902, a third analysis was made, showing great improvement (No. 1144). One spring and two dug well samples were also received from Fergus Falls. They are represented by Nos. 1141-43.

New Richmond—The Village of New Richmond, through Professor Flather, sent in two samples of a deep well they were drilling. The first sample (No. 1030) was taken at a depth of 134 feet, and after passing through the following strata.

Yellow clay		14 ft.
Blue clay		66 "
Blue hard pan		12 "
Yellow hard pan		18 "
Soft rock		16 "
Gray limestone	(water)	5 "
Hard limestone		3 "
		134 ft.

The second sample was sent when a depth of 166 feet was attained. The bottle, however, yielded a strong bay rum odor, which may account for the nitrites found (No. 1040). A laboratory container was sent for a new sample.

Hutchinson—No. 1131 represents a well from Hutchinson. The sample was sent by Dr. Davidson on account of typhoid fever. Its analysis was poor.

Fairmont—The new city well at Fairmont is represented by No. 1134. The sample was sent by Dr. Ludtke. The depth of the well is 185 feet, passing through loam two feet, yellow clay 10 feet, and blue clay 173 feet. The analysis was considered good for a deep well water.

Lindstrom and St. Paul—No. 1133 represents a good Lindstrom spring, and No. 1135 a bad well at Bird lake, near St. Paul. The samples were sent in by private citizens.

Alexandria—Nos. 1145-6 and Nos. 1136-7 represent samples of water and of ice sent by Mr. Hiebel, secretary of the Board of Health of Alexandria. No. 1136 represents the Alexandria village water supply. The well is dug 30 feet deep and 20 feet wide, with brick curbing. There are two vaults within 75 feet, and the analysis was bad. We recommended removal of the two out-houses. No. 1137 represents a sample of Lake Henry ice. This lake is connected with Lake Agnes, into which the sewer of Alexandria runs. Samples of the waters of both these lakes were asked for and sent. Their analyses are shown under Nos. 1145-46. We advised against using this ice.

Bricelyn—Certain deep wells in this village were used as bottomless cesspools to drain dirty cellars and as general means of sewage disposal. Very shortly the deep well water in the vicinity became fouled, and specimens were sent for examination. Their analyses are shown under Nos. 1138-39 and Nos. 1148-50. No. 1138 was 50 feet from a "drain" well. No. 1139, the village well, was 50 feet farther away. No. 1148 was 700 feet from the drain well. Its data were barely passable, and we advised a second examination, lest possibly the pollution might increase. No. 1149 was within 50 feet of one of the drain wells, and its analysis was quite bad. No. 1150 represents a second sample of the village well, and shows some improvement, due to the closing of the drain wells. We advised further analyses of all the wells in question.

Arlington—A small sample of water from Arlington was sent by Dr. Kanne. It was not sufficient for the ammonia distillations, but enough data were obtained to show a very bad water (No. 1151).

Wytoka—Nos. 1152-55 represent one deep and three shallow well samples, taken by Dr. Wesbrook. Chemical analysis passed the deep well, but condemned the three shallow wells.

Virginia—No. 1156 represents water from the sump of the Lincoln mine. The village contemplated using this water as a public supply. The sample was sent by Dr. Lenont, and we requested a second sample before passing final judgment.

Hardwick—The Hardwick sample (No. 1147) was taken from a bored well by Dr. Berry. The analysis was very poor.

Cambridge—The village of Cambridge, through Professor Flather, sent in a number of well water samples, and one of Rum river. The object of the analyses was to determine the sanitary character of those waters with reference to a village supply. The chemical data are given under Nos. 989-1001.

Detroit City—Fifteen samples of well water were sent in by Detroit City through Mr. H. G. McCart, the city recorder. The wells are represented by Nos. 1060-64, 1074 and 1092-1100. Of these two were school wells, one the city supply, one the hotel drinking water, and the remainder private wells. They were all shallow, and mostly surrounded by the usual vaults, etc.

St. Cloud (the reformatory)—For some years the reformatory took its water supply from an 84-foot dug well. An analysis of May 15, 1900, gave "suspicious" data. The well was then cleaned out and considerable detritus removed. A fresh sample then yielded a passable analysis. This supply, however, was limited, and Superintendent Randall thought of putting in the city water, but when this was condemned he began an independent search for good water on the reformatory farm. Seven samples of possible supplies were sent in, but none were of good quality. At the request of Superintendent Randall, I made a personal inspection of his wells, and advised as to new locations.

The geological condition here is that of a granite cup, with some 25 to 30 feet of drift, chiefly sand and gravel.

Eight wells were driven at different locations, and an abundant supply of good water finally secured. The reformatory analyses are shown under Nos. 943-48 and 971-77. No. 1026 represents a quarry water, in temporary use, but now discarded.

(b) The City—The St. Cloud public water supply is taken from the Mississippi river. This water was first condemned March 13, 1900, on the data of a sample sent by Mr. A. Hussey. This opinion was reaffirmed on samples sent by the health officer, Dr. Beebe, April 25th and May 16, 1900; also on samples I personally collected

June 22, 1900. Nevertheless this thrice condemned water was constantly used by many St. Cloud families. An occasional case of typhoid occurred, but little note was taken of it, until along in February of this year, when cases began to multiply to the extent of an epidemic, attacking persons of all classes, and numbering 167 patients. Twenty-one of these patients drank from private wells entirely; a large number from both private wells and from the river. The remainder, a majority, used the river water exclusively. The health officer, Dr. Dunn, in a strongly worded circular, advised that all drinking water be boiled, and the epidemic immediately began to diminish. Fearing for the safety of private wells, Dr. Dunn requested a general chemical examination of all private wells in St. Cloud.

The city wells are usually driven in the sand, or dug through the hard pan; some are driven through certain softer clays. Most of the wells are environed by cess-pools, out-houses, or other sources of pollution, and consequently give evidence of sewage infiltration, especially in the so-called cess-pool district.

These facts materially lightened the work, as a poor field analysis, combined with a poor environment, was taken as ample cause for condemnation. We were thus in a very large number of examinations able to exclude the ammonia distillations, and the estimation of organic oxygen.

June 14th the work was completed. One sample of lake, one of creek water, three samples of ice, five springs and 421 well waters were collected and analyzed. In addition, 70 samples of well and spring water were collected by individuals, and taken to the normal school for examination. This brought the total up to 501 analyses. Of these we were able to pass three springs and 98 wells, or a total of 101 out of 501 examined. As these analyses belong neither to the routine laboratory series, nor to the chlorine survey series, I class them together under "Field Analyses at St. Cloud."

Under laboratory analyses Nos. 951-965 is shown a series of wells personally collected at the request of the St. Cloud Waterworks Co. The object of these examinations was to determine the availability of the upper levee well (No. 952) for a city supply. Nos. 1106 and 1118-20 represent samples sent in before the general examination. The last two were from the principal hotels in St. Cloud. Nos. 1113-14 represent samples sent in by Mr. Geo. L. Wilson of St. Paul. They gave evidence that the intake pipe drew ground water. Nos. 1033-34 represent tap and tank samples of the city supply (Mississippi river) at St. Cloud, taken by Dr. Wesbrook.

LABORATORY ANALYSES.

ANALYTICAL DATA IN PARTS PER 100,000.

No.	Taken at	Name.	Chlorine.	Nitrites.	Nitrates.	Consumed Oxygen.	Ammonia. Free.	Ammonia. Albuminoid.
711	Madelia	Dr. McCarthy, bored well	.74	Marked	Strong	.62	Exc.	.012
712	Sherburn	Dr. Farrish, bored well	1.3	"	"	.36	.014	.024
713	"	Dr. Farrish, bored well	.7	Absent	"	.24	.012	.010
714	Sparta	J. Holub, barrel sunk	.7	"	"	.36	.012	.014
715	"	" dug well	12.4	Strong	"	.22	.032	.020
716	"	" "	1.4	Distinct	"	.32	.012	.017
717	"	" "	1.3	"	"	.34	.015	.020
718	Sleepy Eye	Dr. Kilbride, well	8.5	"	Marked	.32	.014	.020
719	Fayal	Board of Health, dug well	.25	"	Strong	.32	.001	.004
720	"	" " "	.5	S. trace.	"	.24	.001	.001
721	"	" " "	1.12	"	"	.32	.006	.020
722	"	" " "	.6	Marked	"	.28	.007	.020
723	"	" " "	.15	Absent	Absent	.20	.003	.017
724	"	" " "	.4	"	S. trace.	.32	.012	.026
725	"	" " "	.15	"	"	.22	.003	.00
726	Mankato	Hubbard & Palmar, artesian well	.5	"	Trace	.12	Exc.	.002
727	"	Dr. Holbrook, dug well	2.9	Trace	Strong	.32	.008	.007
728	McKinley	Dr. Farmer, iron mine	.2	Absent	Trace	.11	Abs.	Abs.
729	"	Dr. Farmer, test pit	.2	"	Marked	.21	.010	.00
730	Eveleth	Dr. C. W. More	2.5	Strong	Strong	.36	.007	.028
731	"	Dr. C. W. More, driven well	.142	Absent	Trace	.09	.009	Abs.
732	"	Dr. C. W. More, tap	.17	"	Strong	.24	.008	.005
733	"	Fayal mine, sunk	.14	"	Absent	.08	.002	.001
734	"	Old pumping station	.19	"	V. str'g.	.36	.008	.009
735	"	Dr. More, Lake	.22	S. trace.	Strong	.34	.003	.007
736	Fayal	Dr. Harwood	2.1	Strong	"	.36	.018	.022
737	McKinley	Dr. Farmer, dug well	.15	Trace	Marked	.12	.022	.006
738	"	Village tank	.14	Absent	"	.06	.00	.00
739	Owatonna	State public school well	.24	Trace	Distinct	.24	.060	.004
740	"	State public school, barn tap	.19	Marked	Marked	.22	.028	.004
741	Minneapolis	J. E. Davis, dug well	2.9	Trace	Trace	.024	.016	.040
742	Milan	Mr. Opjorden, dug well	.15	Absent	Strong	......	......	......
743	"	Mr. Opjorden, dug well	2.8	Marked	"	......	......	......
744	Elbow Lake	Dr. Per Oyen	.15	Absent	"	.22	.010	.028
745	Rochester	State Insane Hospital	.4	"	"	.024	.00	.002
746	"	State Insane Hospital	.2	"	Distinct	.010	.005	.002
747	"	Zumbro River	.30	Distinct	Marked	.19	.006	.008
748	Chatfield	City tap	.20	Absent	"	.12	.002	.010
749	"	River	.25	F. trace.	Strong	.10	.010	.012
750	Brainerd	R. R. Wise, dug well	.20	Absent	Trace	.26	.032	.034
751	Sacred Heart	J. Thor, dug well	1.2	Trace	"	.14	.010	.002
752	"	Dug well	.51	Absent	Absent	.22	.024	.010
753	Franklin	Dr. H. B. Cole, well	.35	"	Strong	.16	.009	.011
754	Minneapolis	Prof. Flather, spring	.45	"	Absent	.632	Exc.	.026
755	"	Prof. Flather, spring	.45	.032	.041	.036	"	.018
756	Sacred Heart	Mr. O'Connor, spring	.15	Absent	Strong	.012	.006	.018
757	Crookston	T. A. Hoverstad, well	8.5	"	Absent	.012	.010	.024
758	Madelia	Dr. McCanby, dug well	4.5	Marked	Strong	.030	.011	.018
759	Wabasha	Dr. Kelly, driven well	.6	Absent	"	.12	.012	.041
760	"	Dr. Kelly, driven well	2.0	Marked	"	.10	.012	.032
761	Milan	O. K. Opjorden, dug well	.184	Absent	"	.026	.006	.008
762	"	O. K. Opjorden, dug well	1.84	Marked	"	.16	.009	.012
763	"	Mr. Peterson, dug well	1.7	Distinct	"	.16	.010	.009
764	Luverne	Wm. Baterson, dug well	.50	Absent	Trace	.200	.012	.020
765	Hayfield	Village, drilled well	.35	"	"	.12	.020	.009
766	Owatonna	State School well	.08	"	"	.016	.028	.014
767	"	Tank at school well	.09	"	"	.012	.058	.006
768	"	Cistern	.35	Trace	Strong	.12	.007	.020
769	"	Cistern 1, 2 and 3	.142	S. trace.	"	.10	.006	.012
770	Minneapolis	Prof. Flather, spring	.3	Absent	Absent	.12	.070	.005
771	"	Prof. Flather, spring	.30	"	"	.14	.090	.006
772	Pipestone	N. W. Lake	.35	"	"	.52	.020	.034
773	"	East Lake	.35	"	.0012	.62	.020	.036
774	Rush City	Public school well	.3	"	.0001	.22	.005	.036
775	Wabasha	Dr. Kelly, driven well	2.7	Trace	Strong	.42	.028	.012
776	"	Dr. Kelly, driven well	4.0	"	"	.51	.010	.014
777	Fergus Falls	Dr. McLean, well	.48	"	"	.12	.004	.006

Abbreviations—Exc., Excessive; Abs., Absent; F. trace, Faint trace; V. str'g, Very strong.

LABORATORY ANALYSES—*Continued.*

ANALYTICAL DATA IN PARTS PER 100,000.

No.	Taken at	Name.	Chlorine.	Nitrites.	Nitrates.	Consumed Oxygen.	Ammonia. Free.	Ammonia. Albuminoid.
778	Luverne..........	Village well...	1.9	Absent.	Strong..	.12	.004	.006
779	Monticello........	Big lake.................	.088	"	Absent.	.10	.004	.012
780	Elbow Lake......	Melted ice................	.15	"	"	......	.003	.010
781	Minneapolis......	Mr. Donahue, driven well....................	.5	Trace ..	Strong..	.23	.015	.014
782	Dodge Center....	M. R. Dresback, bored well....................	6.0	"	"	.24	.014	.015
783	Redwood	Dr. Gibson, bored well..	.25	S. trace	S. trace	.30	.012	.016
784	Elbow Lake......	Village ice..............	.15	Trace...	Strong..	.31	.012	.028
785	Olivia	Village, drilled well.....	1.0	Absent.	"	.32	Exc,	.038
786	Wadena....	J. J. McKinney..........	3.0+	Strong..	"	.24	.024	.016
787	Sleepy Eye.......	Ice.......................	.25	S. trace	Marked	.16	.004	.004
788	Redwood Falls...	Dr. Gibson, bored well ..	.20	Trace ..	Trace ..	.25	.008	.010
789	Wadena..........	J. Luddell, driven well..	2.8	"	"	.12	.018	.004
790	Canby............	C. R. Hill, dug well......	3.6	Marked	Strong .	.092	.014	.005
791	Graceville........	Tokua Lake ice.........	.10	Distinct	Trace...	.26	.030	.026
792	New Brighton ...	School, well.............	.60	Strong .	Strong .	.632	.032	.024
793	Brainerd.........	Creek near town........	.142	Absent.	Trace...	.42	.020	.030
794	Anoka............	Village supply..........	.142	Marked	Marked	2.3	.042	.068
795	"	Dr. Rees, faucet.........	.142	Trace...	"	1.8	.022	.042
796	"	" "	.142	" ...	"	1.75	.032	.040
797	Tracy............	Dr. Valentine, bored well	1.80	Absent	Distinct	.21	.024	.028
798	Minneapolis	E. B. Johnson, bored well	1.40	" ..	Marked	.32	.014	.028
799	Herman..........	Dr. Larson, bored well..	4.5+	Strong .	Strong .	1.4	.066	.050
800	Elbow Lake......	Indian Med. Sp., direct.	.142	Absent.	Distinct	.012	.002	.001
801	Minneapolis......	" " " car tank	.142	"	"	.012	.002	.001
802	"	" " " yd. tank	.142	"	"	.014	.003	.002
803	"	" " " bottled..	.142	"	"	.016	.002	.002
804	"	" " " wag. tk.	.142	"	"	.114	.003	.003
805	"	" " " "	.142	"	"	.016	.003	.002
806	"	" " " "	.142	"	"	.012	.004	.001
807	Anoka............	Rum river	.142	Absent.	Trace...	1.4	.028	.038
808	Garvin...........	C. Helleson	.48	Distinct	"	......	......	......
809	"	C. Helleson	3.0+	Very str'g	Strong..	......	......	......
810	Rochester..... ..	City supply.............	.70	Trace ..	Very str'g	.14	.018	.005
811	"	Tap at pumping station.	.70	" ..	Strong..	.16	.016	.006
812	"	Zumbro river............	.40	Marked	"	.42	.030	.026
813	"	Bear creek	.40	Distinct	"	.12	.044	.009
814	"	St. Hosp'l, shallow wells	.30	Absent.	"	.099	.006	.003
815	"	St. Hosp'l, deep well...	.15	"	Absent.	.14	.010	.008
816	"	Cascade creek	.20	"	Trace...	.42	.052	.050
817	Wadena..........	John Marshall, spring...	.20	"	Absent.	.14	.024	.002
818	Milan.............	T. Johnson, dug well....	.20	Marked	Trace ..	.18	.012	.024
819	Montevideo......	Mont. Bott'g Co., spring	1.00	"	Strong..	.16	.025	.010
820	"	O. T. Axness, well.......	.70	Trace ..	Marked	.24	.020	.018
821	"	G. Elenson, well.........	6.70	" ..	Strong..	.32	.020	.022
822	Garvin...........	C. Helleson, dug well....	.25	Marked	Trace ..	.24	.012	.026
823	"	C. Helleson, bored well.	.25	"	"	.104	.010	.014
824	St. Paul..........	Chippewa Spr. Wat. Co.	.142	.00......	Strong..	.009	.008	.004
825	Milan	O. K. Opjorden, well....	3.+	Distinct	"	.42	.017	.026
826	"	E. S. Morstad, well.. ...	.40	Marked	Marked	.42	.012	.025
827	Grand Rapids ...	Dr. T. Russel	.14	Absent.	Absent.	.12	.018	.010
628	Eden Valley.....	M. Foley, well	1.8	"	Strong..	.41	.010	.024
829	Granite Falls	Public spring............	.50	Strong..	"	.42	.012	.016
830	Park Rapids......	H. Alexandre, spring....	.10	Absent.	Absent.	.26	.015	.005
831	Princeton........	W. H. Ferrell, well......	6.0	Strong .	Strong..	.42	.036	.036
832	Eveleth..........	Dr. Harwood	1.8	Trace...	Trace ..	.42	.030	.016
833	Stillwater........	Lake McKusick..........	.09	Absent.	Ft.trace	.86	.020	.048
834	Olivia	Dr. Meaker, well........	8.5+	Distinct	Very str'g	.24	.015	.026
835	Kilkenny	J. F. Macdonald, well ...	2.65	Strong..	Strong..	.26	.012	.014
836	N. Mankato......	School supply...........	1.2	Trace ..	"	.14	.012	.024
837	"	A. Anderson, driven w'l	1.5	Distinct	"	.18	.010	.018
838	"	Mr. Nelson, driven well.	.80	"	"	.14	.012	.019
839	Hendricks........	R. R., well	.40	Ft.trace	Trace ..	.12	.024	.014
840	St. Cloud.........	Lower levee well........	.40	Absent.	Strong..	.12	.003	.009
841	"	Lower levee spring......	.45	Ft.trace	"	.18	.008	.008
842	"	Upper levee flowing well	1.3	Absent.	Ft.trace	.09	.008	.008
843	"	Mr. Mitchell's dug well.	2.0	"	Strong..	.12	.002	.010
844	"	Dr. Dunn, well..........	5.5	"	"	.12	.001	.010

LABORATORY ANALYSES—*Continued.*

ANALYTICAL DATA IN PARTS PER 100,000.

No.	Taken at	Name.	Chlorine.	Nitrites.	Nitrates.	Consumed Oxygen.	Ammonia. Free.	Ammonia. Albuminoid.
845	St. Cloud	Anna Lindt's drivenw'l.	.25	Absent.	Marked	.10	.002	.010
846	Kenyon	Town well	3.5	Marked	Strong..	.24	.010	.007
847	"	Town supply at tap	5.25	S. trace.	"	.28	.001	.004
848	"	Dr. Gates, well	10.5	Marked	Very str'g	.22	.006	.026
849	"	Commercial Hotel, well.	6.5	Strong.	Strong..	.28	.010	.032
850	Faribault	Mr. Brandt, spring	.30	Absent.	Distinct	.14	.001	.018
851	Byron	Branch of Zumbro	.35	"	Absent.	.35	.026	.030
852	Pine Island	Town well dug and dr'ld	.30	Distinct	Distinct	.26	.015	.014
853	Zumbrota	Town well drilled 210 ft.	.15	Absent.	Absent.	.108	.010	.006
854	"	Melted ice	.15	"	"	.16	.008	.006
855	Kenyon	Town well dug 20 ft.	3.5	Trace...	Very str'g	.14	.010	.007
856	"	Commerc'l Hotel, dg. w'l	11.9	Marked	"	......	.012	.016
857	Faribault	Mxd. City Water {2 dr'ld / 2 dug} wells	.30	Absent.	Trace..	.15	.006	.006
858	"	1st shallow	.20	"	Distinct	.14	.010	.018
859	"	2d shallow	.25	"	"	.12	.012	.020
860	Northfield	City well, 647 ft., drilled	.10	"	S. trace	.08	.034	.010
861	"	Melted ice.	.10	"	Absent.	......	.008	.007
862	Faribault	Roadside well	1.5	"	"	......	.016	.024
863	"	Cedar Lake	.15	"	S. trace.	......	.015	.012
864	Shieldville	Lake Mazaska	.15	"	Absent.	......	.011	.016
865	Faribault	Fox Lake	.15	"	S. trace	......	.010	.015
866	Le Sueur	City well, drilled, 667 ft.	2.5	"	Absent.	.20	.072	.003
867	"	Melted ice	.10	Trace...	Trace...	......	.050	.012
868	Ottawa	Village well, 457 ft., flowing	10.00	Absent..	Absent.	......	.009	.005
869	St. Peter	Lake Emeley	.25	"	"	......	.022	.060
870	"	St. In. Asylum, flowing.	6.25	"	"	......	.090	.004
871	"	Minn. river ice	.10	Distinct	Trace..	.624	.032	.020
872	"	City Artes., flowing, 200 ft	.20	Absent..	Absent.	.16	.080	.003
873	"	Mx. city supply, one dug, one Artes	.20	"	"	.24	.076	.003
874	Sleepy Eye	Lake Hanska	.50	"	"	......	.014	.012
875	"	Town well, bored, 98 ft..	9.10	Marked.	Strong.	.16	.011	*.012
876	"	School well, 198 ft	.70	Absent.	Distinct	......	Exc.	.012
877	New Ulm	City well, No. 1, 200 ft...	11.5	Trace...	Absent.	......	.104	.005
878	"	" No. 2, 200 ft...	12.75	"	"	......	.096	.005
879	"	" No. 3, 200 ft...	11.5	"	"	......	.072	.005
880	"	J. Hanenstein, brewery, well...	8.0	Absent..	"	......	.124	.004
881	"	" " springs	1.1	"	Strong.	......	.001	.001
882	"	C. Hanenstein, dr'ld well	1.2	"	Absent.	......	.005	.005
883	"	A. Schell, brewery, well	4.0	"	"	......	.120	.005
884	"	Minn. river at bridge	.50	Distinct	Strong..	......	.012	†.016
885	"	H. Frenzel, shallow spring well.	5.9	S. trace.	"	.10	.004	.003
886	Glenwood	Town reservoir	.10	Trace...	"	......	.012	.014
887	"	Bottl'g Co., mx. city sp'g.	.10	"	"	.14	.012	.013
888	Springfield	City, flowing well	.10	Marked	Trace..	.17	.012	.014
889	"	Bottling Co., flowing w'l	.10	Absent..	Absent.	.15	.004	.006
890	"	Ice from Cottonwood rv.	.10	"	"	.10	.008	.009
891	Sanborn	Village well	.50	"	Distinct	.10	.062	.007
892	Revere	Revere, new town well.	1.9	"	Absent.	.066	Exc.	.008
893	"	H. H. Dahl, well	2.0	Distinct	"	.099	.090	.008
894	"	C. O. Nicols	2.5	S. trace.	"	.055	.045	.008
895	" 4½ mi. W.	Joe Wiggins	2.0	Absent..	"	......	.055	.007
896	Walnut Grove, 8 mi. S.E.	Joe Enstad	2.0	S. trace.	"	......	.060	.009
897	Lamberton	City well	7.9	Strong..	Strong..	.198	.003	.005
898	Lamberton, 11½ mi. S.E	C. Kron, flowing well	.25	Absent..	Trace..	.09	.012	.004
899	Walnut Grove, 7 mi. N.W.	E. Wilson, flowing well.	3.0	"	Absent.	......	.005	.004
900	"	Town well	2.1	Marked.	Distinct	.50	.012	.006
901	"	School well	2.05	Distinct	Marked	.13	.002	.006
902	Vesta, 12 mi. S.W.	S. Moulten, well	11.6	Trace...	Absent.	......	.025	.005
903	Winthrop	Town well	.10	Absent.	S. trace	.40	.010	.003
904	Gaylord, 10 mi. N.	N. shore of High Is. L...	.40	"	Absent..	......	.016	.014
905	Henderson	City flowing well	1.1	"	"	.228	.010	.005
906	New Prague	City well	.10	"	"	......	.016	.004
907	Jordan, 12 mi. N.	Minn. river at Shakopee	3.8	"	S. trace.	......	.012	.020
908	" 14 mi. N.E.	Prior Lake at Grainwood	.20	"	Absent.	.40	.010	.015
909	" 15 mi. E..	Prior Lake village well	.20	"	S. trace	.16	.010	.016
910	Red Wing	R. W. Brewery flow. art.	3.50	"	Absent..	.09	.030	.003

* Note difference between this and field analysis No. 1398.

† Note difference between this and field analysis No. 1481.

LABORATORY ANALYSES—*Continued.*

ANALYTICAL DATA IN PARTS PER 100,000.

No.	Taken at.	Name.	Chlorine.	Nitrites.	Nitrates.	Consumed Oxygen.	Ammonia. Free.	Ammonia. Albuminoid.
911	Red Wing........	Sewer Pipe Co., flow. art.	8.50	Absent.	Absent.	.08	.030	.002
912	"	D.R.W.&S.R.R. " "	11.50	"	"	.10	.030	.002
913	"	Minn. Stoneware Co. " "	8.50	"	"	.12	.040	.004
914	"	Mr. Danforth's " "	17.50	"	"	.12	.060	.003
915	"	Mr. D. Peterson's " "	14.00	"	"	.14	.070	.005
916	"	R. W. Poor Farm's " "	32.00	"	"	.15	.090	.007
917	"	Rich Sewer Pipe Co's " "	5.00	"	"	.06	.030	.001
918	"	R. W. Gas Co.'s " "	3.00	"	"	.07	.030	.001
920	"	C.M.&St.P. R.R. " "	11.00	"	"	.09	.030	.003
921	"	La Grange Mills " "	4.00	"	"	.10	.025	.005
922	"	R. W. Training School. dug well	6.00	"	Strong..	.18	.025	.005
923	New Ulm	Hanenstein's shal'w No.2	1.20	"	Absent.	.12	.007	.004

CHEMICAL EXAMINATION OF WATER FROM BIWABIK.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia. Free.	Ammonia. Albuminoid.	Consumed Oxygen.
921	Dr. C.W. Bray....	Town well................	0.15	Absent.	S. trace.	.007	.005	......
930	" " "	Town well................	0.30	S. trace.	Marked	.012	.009	0.16
989	" " "	190 ft. dug and dril'd well	0 30	Trace ..	"	.006	.007	0.14

CHEMICAL EXAMINATION OF WATER FROM EVELETH.

922	Dr. W. E. Harwood............	Well	0.30	Absent.	S. trace.	.018	.002	0.08
923	Dr. W. E. Harwood...........	Tank sample............	0.30	.00......	"	.018	.003	0.09

CHEMICAL EXAMINATION OF WATER FROM CLAREMONT.

924	Dr. O. F. Way....	20 ft. bored well..........	0.80	Absent.	Marked	.003	.002	0.09
925	" " "	14 ft. bored well..........	0.60	"	Trace ..	.006	.010	0.08

CHEMICAL EXAMINATION OF WATER FROM WABASHA.

926	Dr. Milligan......	35 ft. driven well	2.50	Absent.	Strong..	.010	.009	0.20
927	" "	40 ft. driven well	2.20	Trace ..	"	.016	.012	0.26
928	" "	Driven well..............	4.60	"	"	.012	.010	0.24

CHEMICAL EXAMINATION OF WATER FROM WABASSO.

929	Dr Lucas........	51 ft. bored well..........	0.30	Trace ..	Distinct	.024	.010	0.24

CHEMICAL EXAMINATION OF WATER FROM ST. LOUIS PARK.

931	Mr. W. C. Otts....	83 ft. driven well	0.40	Absent.	Distinct	.026	.016	0.22
932	" " "	58 ft. " "	0.40	"	Strong..	.007	.012	0.20
933	" " "	50 ft. " "	0.40	"	"	.003	.001	0.09
934	" " "	55 ft. " "	0.50	Trace ..	"	.010	.028	.126
935	" " "	52 ft. " "	0.45	Absent.	Distinct	.014	.012	0.18

CHEMICAL EXAMINATION OF WATER FROM LAKEVILLE.

936	Board of Health..	28 ft. dug and driv'n well	2.10	Absent.	Strong..	.006	.006	0.12
937	" " ..	28 ft. " " "	10.2	Distinct	"	.009	.012	0.14
938	" " ..	28 ft. " " "	2.20	Absent.	"	.005	.009	0.18
939	" " ..	28 ft. " " "	3.80	Distinct	"	.007	.010	0.20

Abbreviations—S. trace-small trace. Exc.-excessive. V. strong-very strong.

CHEMICAL EXAMINATION OF WATER FROM LAKE MINNETONKA.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia.		Consumed Oxygen.
						Free.	Albuminoid.	
940	Dr. Dickinson....	Driven well.............	0.40	Absent.	Absent.	.006	.007	0.10

CHEMICAL EXAMINATION OF WATER FROM HOPKINS.

941	Mr. Lindsley.....	25 ft. dug well...........	1.50	Strong..	Strong..	.024	.022	0.21

CHEMICAL EXAMINATION OF WATER FROM SPRINGFIELD.

942	Mr. Leacherman.	35 ft. bored well.........	0.40	Trace ..	Strong..	.030	.010	0.22

CHEMICAL EXAMINATION OF WATER FROM FRAZEE.

966	Dr. S. S. Jones...	Dug well.................	0.60	S. trace.	Strong..	.005	.008	.10

CHEMICAL EXAMINATION OF WATER FROM ALBERT LEA.

949	Dr. Burton.......	New city well, 450 ft. D..	0.20	Absent.	Absent.	Exc.	.006	0.09
950	" "	Settling tank............	0.20	Trace ..	S. trace.	"	.009	0.10

CHEMICAL EXAMINATION OF WATER FROM MANKATO.

967	Dr. Anderson....	42 ft. shallow well........	2.50	Marked	Strong..	.014	.010	0.12
985	Dr. Holbrook....	Driven well, 25 ft........	1.00	Absent.	Marked	.004	.004	0.12

CHEMICAL EXAMINATION OF WATER FROM MONTEVIDEO.

968	Mr. H. N. Bergh.	Lake (at bottom)........	0.10	Absent.	Absent.	.012	.028	0.18
969	" "	Lake (at 5 ft.)...........	0.10	"	"	.014	.028	0.18

CHEMICAL EXAMINATION OF WATER FROM MINNEAPOLIS.*

978	Mr. Morris.......	Spring....................	0.10	S. trace.	Trace .	.008	.010	0.10
1027	Geo. M. Maloy...	Flowing artes. 507 ft.....	0.20	Absent.	S. trace.	.034	.0015	.04
1122	Mr. Gould........	Spring....................	0.15	"	Absent.	......	......	......
1127	Mr. Swenson.....	Dug well, No. 1..........	1.20	Trace ..	Strong..	.001	.004	......
1128	" "	Dug well, No. 2..........	1.30	"	Marked	.004	.003	......

*Residue: Total, 32.0; Volatile, 6.4

CHEMICAL EXAMINATION OF WATER FROM MORTON.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia.		Consumed Oxygen.
						Free.	Albuminoid.	
979	Dr. F.W. Penhall	Well	0.70	Trace	Strong	.001	.001	0.08
986	" " "	Good Thunder well	1.10	Marked	"	.020	.014	0.12
987	" " "	Spring	0.30	"	Marked	.002	.020	0.24

CHEMICAL EXAMINATION OF WATER FROM LUVERNE.

980	Dr. Guthrie	Dug well	1.20	Absent	Strong	.001	.003	0.08

CHEMICAL EXAMINATION OF WATER FROM FRANKLIN.

981	Dr. Cole	Bored well, 80 ft.	0.80	Absent	Marked	.025	.010	0.16
982	" "	Village water w'rks tank	0.20	"	Absent	.028	.007	0.12

CHEMICAL EXAMINATION OF WATER FROM DEXTER.

983	Dr. Schottler	Driven well, 150 ft.	0.20	Strong	Marked	.007	.016	0.14

CHEMICAL EXAMINATION OF WATER FROM CLINTON.

988	Mr. J. B. Babcock	School well	0.30	Marked	Strong	.006	.005	......

CHEMICAL EXAMINATION OF WATER FROM MADELIA.

1002	Dr. McCarthy	30 ft. bored well	1.20	Distinct	Marked	.009	.012	0.16
1059	" "	68 ft. drove well	2.34	Absent	Absent	.045	.054	0.51

CHEMICAL EXAMINATION OF WATER FROM ADAMS.

1003	Dr. Knight	House well	0.25	Absent	Trace	.004	.003	0.10
1004	" "	Barn	0.20	"	"	.020	.010	......

CHEMICAL EXAMINATION OF WATER FROM KENYON.

1005	Dr. Gates	75 ft. drilled well	1.30	Absent	Strong	.006	.004	0.09
1006	" "	26 ft. dug well	8.40+	Marked	"	.013	.018	0.14

CHEMICAL EXAMINATION OF WATER FROM PIPESTONE.

ANALYTICAL DATA IN PARTS PER 100,000,

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia. Free.	Ammonia. Albuminoid.	Consumed Oxygen.
1111	Dr. Jenckes......	17 ft. dug well...........	7.20	Trace ..	Strong..	.022	.020	0.16
1007	“ “	Vil'ge supply, 3 dug wells	1.20	Distinct	“	.007	.004	0.08
1029	“ “	Vil'ge supply, 3 dug wells	1.80	“	“	.008	.008	0.09
1110	“ “	Ice from Pipestone creek	0.20	Trace ..	Trace ..	.007	.004	0.10

CHEMICAL EXAMINATION OF WATER FROM SLEEPY EYE.

1008	Supt. of Schools..	198 ft. well................	0.70	Absent .	Distinct	Exc.	.012	0.16
1009	Dr. Williams, Jr..	Village well, bored 90 ft.	9.10	Marked	Strong..	.011	.012	0.16
1031	Dr. Strickler.....	50 ft. bored well.........	0.20	Distinct	“	.010	.006	0.16

CHEMICAL EXAMINATION OF WATER FROM SANBORN.

1010	Dr. Bennett......	Bored well, 32 ft	1.00	Distinct	Strong..	.014	.008	.104
1011	“ “	Cistern supplied by 300 ft. well................	.50	Absent .	Distinct	.062	.007	.010

CHEMICAL EXAMINATION OF WATER FROM CLAREMONT,

1012	W. G. Doepping.	12 ft. drove well.........	0.50	Trace ..	Strong..	.010	.014	0.16
1013	“ “	15 ft. dug well	1.20	S. trace	Trace ..	.014	.022	0.22
1014	“ “	16 ft. dug and drove well	0.50	Absent .	Distinct	.010	.011	0.18
1015	“ “	18 ft. dug and drove well	0.90	Distinct	Strong..	.015	.022	0.19
1016	“ “	18 ft. dug and drove well	3.50	Absent .	“	.012	.026	0.22

CHEMICAL EXAMINATION OF WATER FROM BRAINERD.

1017	H. C. Carel.......	Rice Lake................	0.10	S. trace	Trace ..	.006	.024	0.89
1018	“	Mississippi River........	0.10	“	Distinct	.006	.024	0.88
1019	“	Mississippi at dam.......	0.10	“	“	.005	.024	0.87
1020	“	Mississippi reservoir pump..................	0.10	“	“	.005	.024	0.89
1021	“	Mississippi, filtered.....	0.10	“	Marked	.005	.018	0.87
1022	“	City tap..................	0.10	“	“	.004	.020	0 93

CHEMICAL EXAMINATION OF WATER FROM NEW ULM.

1023	Dr. G. F. Reineke	Minn. River, 3 mi. above	0.40	S. trace	Strong..	.080	.022	0.86
1024	“ “	Cottonwood River.......	0.50	Trace ..	Distinct	.003	.026	0.94

CHEMICAL EXAMINATION OF WATER FROM HERON LAKE.

1025	O. C. Ochs........	140 ft. bored well........	0.20	Strong..	Strong..	Exc's.	.022	0.86
1066	Dr. Kellam.......	Dug well..................	21.15	S. trace	Distinct	None.	.005	.085
1091	“ “	“	16.50	Strong..	V.strn'g	.006	.018	0.18

CHEMICAL EXAMINATION OF WATER FROM OAKLAND.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia.		Consumed Oxygen.
						Free.	Albuminoid.	
1028	F. Morgan........	100 ft. tubular well......	0.15	S. trace	Absent.	exc.	.006	0.36
1042	"	100 ft. tubular well......	0.15	"	Trace ..	"	.007	0.34

CHEMICAL EXAMINATION OF WATER FROM EDINA.

1030	H. C. Carel.......	Minnehaha creek........	0.40	Trace ..	Trace ..	exc.	.120	1.49

CHEMICAL EXAMINATION OF WATER FROM FARMINGTON.

1032	T. H. Lintner....	....	0.25	S. trace	Marked	.003	.006	0.18
1041	H. G. Otte........	40 ft. tubular well........	0.15	Absent.	Absent.	.002	.002	0.10

CHEMICAL EXAMINATION OF WATER FROM OWATONNA.

1076	Dr. Adair........	Reservoir................	0.31	Trace ..	Marked	.046	.002	0.10
1035	"	Dug 20 ft................	0.70	Marked	Strong..	.020	.006	0.42
1036	"	City well, 80 ft. deep....	2.10	Trace ..	Marked	.016	.003	0.22
1077	"	City tap..................	0.63	Distinct	"	.051	.052	0.22

CHEMICAL EXAMINATION OF WATER FROM LE SUEUR.

1037	Dr. Le Clerc.....	60 ft. open well...........	5.20	Marked	V.strn'g	.005	.006	0.36

CHEMICAL EXAMINATION OF WATER FROM RUSSELL.

1038	E. C. Jones.......	Well......................	0.25	Absent.	Marked	.008	.020	0.16
1039	Mr. Minik........	"	0.25	"	"	.006	.008	0.12
1040	Dan Fellon.......	"	0.15	"	Absent	.005	.016	0.18
1055	Dr. Weyrens.....	Springs..................	0.25	"	Marked	.005	.008	0.10
1056	"	"	0.15	"	Absent	.005	.002	0.10
1057	"	Redwood River..........	0.25	"	Marked	.008	.020	0.82

CHEMICAL EXAMINATION OF WATER FROM BRUNO.*

1043	Mr. L. Gross.....	Spring..................	0.20	Absent.	Absent.	.012	.005	.019

*Residue: Total, 14.4; volatile, 4.1

CHEMICAL EXAMINATION OF WATER FROM LONG-PRAIRIE.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia. Free.	Ammonia. Albuminoid.	Consumed Oxygen.
1072	Dr. Van Valkenberg ..	18-ft. drove well.........	0.25	Absent.	Absent.	.030	.018	0.18
1044	Village...........	Lake Charlotte..........	0.15	"	S. trace	.008	.012	0.98
1045	"	Long Prairie river.......	0.15	Trace...	Strong.	.022	.010	1.40
1046	"	14-ft drove well.........	0.55	Absent.	Distinct	.002	.002	0.16
1047	"	8-ft. drove well..........	0.75	"	Trace...	.001	.006	0.16
1048	"	Town well, 18 ft. deep...	2.15	Trace...	Strong.	.005	.011	0.14
1065	Dr. Christie......	40-ft. drove well.........	1.40	S. trace.	Absent.	.001	.003	0.12

CHEMICAL EXAMINATION OF WATER FROM ARGYLE.

1084	Dr. Belcourt.....	13-ft. well at lumb. yard.	8.50	Absent.	Strong..	.001	.020	0.12
1049	"	West well, dug, 12 ft....	13.0	Strong..	"	exc.	.018	0.24
1050	"	East well, dug, 11½ ft...	8.50	Absent.	Distinct	.006	.005	0.12
1082	"	Holen's 13½-ft. well.....	17.5	V. st'ng	V. str'g	.018	.036	0.28
1083	"	Mr. S. Tied's well, dug, 13 ft..................	2.50	Marked	Strong..	.016	.020	0.14
1085	"	Mr. O. Perrault, well, dug, 12 ft	3.00	Trace ..	"	.002	.018	0.10
1086	"	Mr. F. W. McKay's well, dug, 16 ft..............	2.00	"	V. str'g	.002	.022	0.12
1087	"	12-ft. dug well...........	16.50	Strong..	"	.018	.026	0.16
1088	"	Mr. A. Boyce, dug well..	....	....	....	......	......	......
1089	"	Mr. M. Novotny's 12-ft. well......................	34.50	Marked	Strong..	.012	.024	0.10
1090	"	East public well, dug. 12 ft......................	8.50	Absent.	Absent.	.008	.006	0.10

CHEMICAL EXAMINATION OF WATER FROM WINTHROP.

1051	Mr. J. Olson	School well, bored, 30 ft.	0.40	Marked	Marked	.016	.020	0.14

CHEMICAL EXAMINATION OF WATER FROM BLAKELEY.

1052	Mr. M. Weldon..	40-ft. dug well...........	7.30	S. trace	Strong..	.012	.016	0.18
1053	" ..	22-ft. dug well...........	10.60	Trace ..	"	.014	.016	0.20
1054	" ..	32-ft. dug well...........	10.80	"	V.str'ng	.012	.014	0.22

CHEMICAL EXAMINATION OF WATER FROM HAMMOND.

1058	Dr. A. J. Button.	28-ft. dug well............	1.12	S. trace	Strong,.	.003	.091	.063

CHEMICAL EXAMINATION OF WATER FROM WARREN.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia.		Consumed Oxygen.
						Free.	Albuminoid.	
1067	Mr. K. J. Taralseth	Mr. Lundgren's flowing well....................	46.0	Marked	Distinct	.012	.006	0.10
1068	"	A. Gunderland's flowing well...............	37.50	Absent.	Absent.	exc.	.010	0.29
1069	"	Mill, flowing well, 150 ft.	122.50	"	"	"	.012	0.42
1070	"	Mr. Shaw's flowing well, 150 ft....................	4.0	Distinct	Strong.	.015	.012	0.52
1071	"	Mr. Wenzell's well, 150 ft.	47.70	S. trace	Trace.	exc.	.006	0.24

CHEMICAL EXAMINATION OF WATER FROM BUHL.

1075	Dr. Shaw.........	Town dug well, 28 ft.....	.10	Absent..	Absent.	.001	.037	0.18

CHEMICAL EXAMINATION OF WATER FROM RED WING.

1078	Dr. Wesbrook...	Training school well, dug, 20 ft...............	6.48	Absent.	Strong..	Abst.	.001	0.19
1079	" " ..	Tank at school...........	6.48	"	"	.017	.002	0.20
1080	" " ..	Tap at school............	6.48	"	"	.080	.008	0.22
1081	" " ..	Mississippi at school.....	.315	S. trace.	Trace...	.009	.033	0.86

CHEMICAL EXAMINATION OF WATER FROM KILKENNY.

1102	Dr. Macdonald...	M. Pierce, 19 ft. well.....	15.7	S. trace.	Strong..	.009	.012	0.12
1103	" " ..	R. Dynes, 20 ft. well.....	7.20	Absent.	"	.010	.012	0.10
1104	" " ..	F. Dusbabee, 19 ft. well..	2.70	S. trace.	"	.010	.007	0.16

CHEMICAL EXAMINATION OF WATER FROM SHADY OAK LAKE.*

1105	H. C. Carel.......	Shady Oak lake, water..	.135	Absent.	Absent.	.005	.050	0.36
1106	" "	" " ice....	.045	"	"	.005	.012	0.10

*1105—Residue: total, 16.4; volatile, 4.2. 1106—Residue: total, 3.0; volatile, 0.5.

CHEMICAL EXAMINATION OF WATER FROM BRITTON.*

1107	C. S. Thorpe......	Dug well, 35 ft. deep....	3.15	Trace...	Strong..	.004	.009	.198
1108	" "	Drilled well, 1000 ft. deep	27.45	Absent.	Absent.	exc.	.006	0.108

*1107—Residue: Total, 46.8; volatile, 3.20. 1108—Residue: Total, 215.6; volatile, 6.4.

CHEMICAL EXAMINATION OF WATER FROM MONTEVIDEO.

1109	Dr. Henderson...	Well	2.90	Trace...	Strong..	.025	.022	0.14

CHEMICAL EXAMINATION OF WATER FROM TWIN VALLEY.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia.		Consumed Oxygen.
						Free.	Albuminoid.	
1112	Dr. A. G. Larson	Mr. Burkhart's well......	0.40	Absent.	Trace ..	.003	.040	0.18

CHEMICAL EXAMINATION OF WATER FROM ROCHESTER.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Free Ammonia.	Albuminoid Ammonia.	Consumed Oxygen.
1115	Dr. Mosse........	Drove well, 34 ft. deep..	0.75	Absent.	Strong..	.003	.007	0.26
1116	"	" 34 "	0.75	"	"	.002	.007	0.26
1117	"	" 34 " ..	0.75	"	"	.003	.011	0.27

CHEMICAL EXAMINATION OF WATER FROM HALSTAD.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Free Ammonia.	Albuminoid Ammonia.	Consumed Oxygen.
1121	Dr Bennett......	Deep well...............	23.95	Marked	Trace ..	exc.	.004	.009

CHEMICAL EXAMINATION OF WATER FROM FERGUS FALLS.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Free Ammonia.	Albuminoid Ammonia.	Consumed Oxygen.
1123	H. C. Carel.......	Ottertail river, above Hill farm..............	0.05	Absent.	Trace ..	.007	.012	1.20
1124	"	Ottertail river, below Hill farm...............	0.15	Trace...	Marked	.016	.020	1.60
1125	"	Ottertail river, at town.	0.10	"	"	.016	.014	1.50
1126	"	Tap at hotel............	0.10	"	"	.014	.012	1.40
1141	C. H. Hoyt.......	Spring....................	3.60	S. trace.	S. trace.	.018	.001	0.09
1132	Dr. Cole..........	Ottertail river, from tap	.075	Absent.	Marked	.001	.016	1.40
1142	A. J. Fellon......	Dug well, 22 ft. deep.....	6.75	Strong..	Strong..	.012	.016	0.14
1143	C. A. Spielman...	"	0.09	Absent.	Absent.	.001	.001	0.09
1144	Dr. Cole..........	Ottertail river..........	.075	"	Marked	.001	.004	1.20

CHEMICAL EXAMINATION OF WATER FROM JACKSON.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Free Ammonia.	Albuminoid Ammonia.	Consumed Oxygen.
1129	Dr. Maitland.....	Dug well, 24 ft...........	1.10	Trace...	Distinct	.002	.002	0.36

CHEMICAL EXAMINATION OF WATER FROM NEW RICHMOND.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Free Ammonia.	Albuminoid Ammonia.	Consumed Oxygen.
1130	Prof. Flather....	Drilled well, 133 ft.......	0.27	Absent.	Distinct	.044	.007	0.10
1140	" "	" " 161 ft.......	0.36	Distinct	"	.032	.004	0.13

CHEMICAL EXAMINATION OF WATER FROM HUTCHINSON.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Free Ammonia.	Albuminoid Ammonia.	Consumed Oxygen.
1131	Wm. Davidson...	Well......................	0.50	Marked	Distinct	.010	:011	0.16

CHEMICAL EXAMINATION OF WATER FROM LINDSTROM.*

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia.		Consumed Oxygen.
						Free.	Albuminoid.	
1133	Lindstrom and Ackerstrom....	Spring....................	0.30	Absent.	Trace ..	.008	.002	.09

*Residue: Total, 30.0; volatile, 4.0.

CHEMICAL EXAMINATION OF WATER FROM FAIRMONT.

1134	Dr. G. H. Luedtke	Drove well, 185 ft. deep..	0.36	Absent.	Trace ..	exc.	.001	.09

CHEMICAL EXAMINATION OF WATER FROM ST. PAUL.

1135	Mr. G. A. Freeman	Bored well, 41 ft. deep...	2.70	Strong..	Strong..	.001	.004	0.16

CHEMICAL EXAMINATION OF WATER FROM ALEXANDRIA.

1145	Mr. J. F. Hiebel..	Lake Henry..............	0.27	Absent.	Marked	.002	.008	1.60
1136	" " ..	Dug well, 20 ft. deep.....	1.08	Trace...	Strong..	.020	.005	0.12
1137	" " ..	Lake Henry ice..........	0.09	Absent.	"	.004	.003	0.09
1146	" " ..	Lake Agnes ice..........	0.36	S. trace.	Marked	.003	.012	2.40

CHEMICAL EXAMINATION OF WATER FROM BRICELYN.

1138	Dr. Nannestad...	Tubular well, 100 ft. deep	11.08	Marked	Marked	.030	.032	0.25
1139	" " ...	Drilled well, 100 ft. deep	1.70	Trace...	Trace ..	.040	.020	0.18
1148	Mr. A. E. Wilcox.	Mr. W. W. Reed's well ..	0.27	"	"	.024	.004	0.14
1149	" " .	Mr. A. E. Wilcox's well..	10.50+	Strong..	V. str'ng	.032	.022	0.19
1150	" " .	Village well, 114 ft.	1.20	Trace.	Marked	.004	.002	0.16

CHEMICAL EXAMINATION OF WATER FROM ARLINGTON.

1151	Dr. Kanne.......	Well......................	19.8+	Marked	Strong..	......	......	2.10

CHEMICAL EXAMINATION OF WATER FROM WITOKA.

1152	Dr. Westbrook...	Geo. Thomas, drove well 270 ft....................	0.18	Absent.	Trace ..	.004	.002	0.08
1153	" "	Grocery store well......	1.35	Trace...	Strong..	.006	.008	0.12
1154	" "	Mr. Monahan's well.....	10.8	Distinct	"	.004	.012	0.14
1155	" "	Mr. Cassener's well.....	9.45	"	"	.007	.010	0.11

CHEMICAL EXAMINATION OF WATER FROM VIRGINIA.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia.		Consumed Oxygen.
						Free.	Albuminoid.	
1156	Dr. Lenont.......	Sump of Lincoln mine...	0.18	Absent.	Marked	.010	.004	0.16

CHEMICAL EXAMINATION OF WATER FROM HARDWICK.

1147	Dr. W. T. Berry..	Bored well, 32 ft. deep...	1.90	Strong..	Strong..	.012	.020	0.18

CHEMICAL EXAMINATION OF WATER FROM CAMBRIDGE.

989	Prof. Flather....	Mill well..................	0.10	Absent.	S. trace.	.005	.010	0.09
990	" "	Creamery well...........	3.00	"	Strong..	.010	.016	0.12
991	" "	Rum River................	0.40	"	Trace..	.008	.026	0.46
992	" "	Mr. D. Anderson's well..	0.10	"	Absent.	.004	.009	0.14
993	" "	Mr. A. Peterson's well...	3.20	"	Strong..	.010	.018	0.16
994	" "	Court House well........	6.50	"	"	.014	.016	0.18
995	" "	Mr. Westlier's well......	5.80	Trace...	"	.012	.020	0.22
996	" "	Mr Southerland's well.	0.70	"	Distinct	.010	.012	0.14
997	" "	Mr. J. Morleen's well...	1.50	Absent.	Strong..	.012	.014	0.13
998	" "	Mr. Gouldsberg's well..	0.15	"	Distinct	.008	.010	0.10
999	" "	" store well	0.15	"	Strong..	.009	.012	0.11
1000	" "	Mr. Starkweather's well	0.15	"	Trace..	.007	.006	0.10
1001	" "	P. Hanson's well.........	0.30	"	Distinct	.003	.005	0.09

CHEMICAL EXAMINATION OF WATER FROM DETROIT CITY.

1060	Mr. H. G. McCart	25 ft. drove well..........	1.40	Strong..	Strong..	.008	.016	......
1061	" "	Mr. Blanding's well, 13 ft. deep................	2.10	Distinct	"	.010	.012	......
1062	" "	Holmes school well, 8 ft. deep......................	1.90	S. trace.	"	.009	.014	......
1063	" "	Washington school, 11 ft. deep.....................	5.10	Strong..	"	.012	.018	......
1064	" "	E. W. Davis' well, drove 15 ft.....................	1.20	Absent.	S. trace.	.010	.009	......
1074	" "	Dr. Carmen's well, 14 ft. deep.....................	2.70	Strong..	Strong..	.016	.020	......
1092	" "	City well.................	3.40	Trace..	Strong..	.020	.019	0.22
1093	" "	Lewis House well........	7.50	Marked	"	.022	.016	.24
1094	" "	Mr. A. G. Wedge's well.	2.70	Strong..	"	0.018	.019	0.28
1095	" "	Mr. Waldorf's well......	0.585	Trace..	Marked	.009	.010	0.16
1096	" "	Mr. Wilcox's well.......	2 60	"	Strong..	.009	.012	0.18
1097	" "	Mr, L. G. Norby's well.	1.00	Distinct	Marked	.010	.014	0.14
1098	" "	Sheridan Hotel well....	2.40	Trace..	Strong..	.012	.016	0.18
1099	" "	Mr. A. F. Snell's well...	0.63	Marked	"	.007	.010	0.14
1100	" "	Mr. G. C. Bush's well...	1.50	Absent.	Marked	.005	.007	0.10

CHEMICAL EXAMINATION OF WATER FROM ST. CLOUD.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia.		Consumed Oxygen.
						Free.	Albuminoid.	
951	Mr. H. C. Carel..	Ice house, spring........	1.40	Absent.	Strong..	.005	.007	.12
952	" " " ..	Upper levee, well........	1.30	"	Absent.	.003	.004	.08
953	" " " ..	Mr. Gilman's well.......	1.70	S. trace.	Strong..	.010	.010	.14
954	" " " ..	Mr. Bennett's well......	1.90	"	Marked	.012	.009	......
955	" " " ..	Mr. Gilman's well.......	1.20	Absent.	"	.015	.010	.14
956	" " " ..	Mr. Carter's well........	1.00	S. trace.	Distinct	.009	.010	.16
957	" " " ..	Mr. Hayward's house....	0.70	Distinct	Marked	.016	.014	.12
958	" " " ..	Mr. Hayward's barn....	1.10	"	V. str'g.	.018	.016	.10
959	" " " ..	Mr. Doyle's well.........	0.45	Absent.	"	.016	.010	.09
960	" " " ..	Mr. Pelton's well........	0.80	"	"	Exc.	.007	.10
961	" " " ..	Fair Grounds............	0.30	"	Strong..	.020	.009	.18
962	" " " ..	Mr. Couper's well.... ...	3.50	Trace...	Distinct	.014	.022	.34
963	" " " ..	Mr. Waite's well........	0.20	Absent.	Absent.	.010	.009	.08
964	" " " .	Great Northern.........	0.70	Marked	Marked	.012	.016	.18
965	" " " ..	Mr. Hollenhurst's well..	0.25	Absent.	Absent.	.012	.020	.22
1106	Mr. R. B. Bower..	Well......................	1.80	Strong..	Strong..	.028	.020	......
1113	Mr. Wilson.......	St. Cloud water supply..	0.20	S. trace.	S. trace.	.007	.022	2.23
1114	" "	Intake pipe after salting	0.85	"	"	Exc.	.028	1.72
1118	Mr. D. S. Hayward	Drove, pt. supply, Hotel	2.65	Distinct	Strong..	.010	.016	0.21
1119	" " "	" " " "	9.90	Trace .	"	.009	.018	0.18
1120	" " "	" " " "	17.50	Distinct	"	.012	.016	0.20
943	State reformat'y	No. 1, drove 18 ft........	0.60	Marked	Marked	.008	.012	0.16
944	" "	West well 22 ft..........	0.50	Trace..	"	.009	.012	0.15
945	" "	West well 27 ft..........	0.50	Marked	"	.009	.012	.016
946	" "	No. 2, East well 14 ft.....	0.20	"	"	.001	.006	0.12
947	" "	" " " 15 ft.....	0.40	"	"	.006	.012	.016
948	" "	" " " 16 ft.....	0.30	"	"	.001	.006	0.10
970	Dr. Brigham.....	Mr. Murphy's, dug 52 ft.	7.20	Trace..	V. str'g.	.003	.012	0.12
971	State reformat'y	27 ft. well................	0.30	"	Strong..	.001	.004	0.09
972	" "	Starkes 14 ft. dug.......	0.30	S. trace.	Marked	.006	.010	0.12
973	" "	Ranch well No. 3 dug 20 ft	1.90	Marked	"	.001	.005	0.10
974	" "	Drove 24 ft..............	0.20	Absent.	S. trace.	.008	.001	0.06
975	" "	Drove 15 ft..............	0.40	S. trace.	"	.010	.006	0.09
976	" "	Mr. Richardson, dug 22 ft	0.20	Absent.	Marked	.001	.005	0.09
977	" "	Dug 86 ft................	1.20	"	Absent.	.006	.010	0.10
1026	" "	Qnarry water...........	0.45	Trace..	Trace..	.020	.036	0.78
1033	Dr. Wesbrook....	Mississippi from tap.....	0.20	"	Strong..	.020	.012	1.82
1034	" " ...	Mississippi from tank...	0.20	Marked	"	.014	.014	2.06

CHEMICAL EXAMINATION OF WATER FROM MINNEAPOLIS.

1261	Dr. Wesbrook...	Mr. Smith's 45-ft. dr'vn w	.50	Absent.	Strong..	.001	.001	.08
1279	A. E. Carr........	West Side Pumping St'n	.09	"	Absent.	.001	.028	.84
1280	"	North Side Pump'g St'n	.09	"	"	.001	.029	.84
1281	"	North Side reservoir....	.075	"	"	.001	.016	.82

CHEMICAL EXAMINATION OF WATER FROM HARRIS.

1262	A. E. Carr......	Goose creek above starch factory.........	.10	.00	Marked	.001	.012	.876
1263	"	Goose creek below starch factory.........	.09	.00	"	.001	.014	.894
1268	"	Goose creek above starch factory........	.07	S. trace	"	.0025	.023	1.29
1269	"	Goose cr. below starch fac., same as No. 1199..	.10	Distinct	Trace..	.192	.814	7.08
1277	H. C. Carel......	Goose cr. 100 ft. above drain of starch factory	.08	Trace..	Marked	.003	.022	1.12
1278	"	Goose cr. 300 yds. below the starch factory.....	.12	Absent.	"	.148	1.042	8.46

CHEMICAL EXAMINATION OF WATER FROM WABASHA.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia.		Consumed Oxygen.
						Free.	Albuminoid.	
1264	John McDonald..	....	1.62	.00	Strong..	.001	.001	.08

CHEMICAL EXAMINATION OF WATER FROM BEMIDJI.

1265	Dr. Morrison	Driven well 30 ft. deep..	1.53	Absent.	Strong.	.001	.001	.08
1284	H. C. Carel.......	Village well driven 35 ft.	1.10	Marked	"	.006	.008	.12
1285	"	Hub Restaurant w. 32 ft.	.40	Trace ..	Distinct	.002	.005	.10
1286	"	Mr. Carson's well 24 ft..	3.5	Absent.	Strong.	.003	.029	.16
1287	"	Svea House well 30 ft....	18.6+	Strong.	"	.008	.030	.20
1288	"	Lake Bemidji, opposite side from Bemidji vil..	.075	Absent.	S. trace	.005	.010	.76
1289	"	Lake Bemidji, 100 ft. off Hotel Markham sewer	.22	Trace ..	Distinct	.018	.014	.080
1290	"	Lake Bemidji, 100 ft. off hospital sewer.........	.24	"	Marked	.013	.016	.78

CHEMICAL EXAMINATION OF WATER FROM CROOKSTON.

1266	Dr. Kjelland.....	Cistern 20 ft. deep.......	6.93	S. trace	Marked	.030	.002	.08
1267	"	Artesian well, bored, 175 ft..................	8.64	Trace...	"	.040	.008	.10

CHEMICAL EXAMINATION OF WATER FROM ROCHESTER.

1270	H. C. Carel.......	Mixed water from 11 drilled and one dug w.	.60	S. trace	Strong,.	.008	.003	.14
1271	"	Bear creek at mouth of drain	.25	Distinct	"	.006	.0001	.36
1272	"	Zumbro river at bridge above Gas Co..........	.40	Absent.	"	.008	.007	.34
1273	"	Zumbro river at dam where ice is cut........	.50	Distinct	"	.020	.010	.57
1274	"	Silver creek above State Hospital...............	.35	Trace...	"	.010	.0083	.52
1275	"	Silver creek below State Hospital...............	.80	Marked	"	.025	.080	.78
1276	"	Shallow wells at State Hospital...............	.55	Absent.	"	.018	.001	.12

CHEMICAL EXAMINATION OF WATER FROM CASS LAKE.

1282	H. C. Carel.......	Village well, driven, 30 ft	.09	Absent.	Trace ..	.002	.003	.06
1283	"	Mr. J. J. Jackson's well, 10 ft. deep.............	.50	"	Marked	.007	.018	.12

CHEMICAL EXAMINATION OF WATER FROM ALEXANDRIA.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia. Free.	Ammonia. Albuminoid.	Consumed Oxygen.
1291	J. F. Hiebel......	35-ft. bored well.........	.14	Absent.	Trace ..	.016	.007	.08
1292	"	60-ft. driven well.......	1.7	"	"	.005	.002	.06

CHEMICAL EXAMINATION OF WATER FROM McKINLEY.

1154	H. H. Salmon....	Lake water filtered......	.22	.00	Trace ..	.012	.010	.14
1156	"	Mixed water from two wells 40 and 60 ft. deep.	.13	.00	.00	.008	.004	.10
1157	"	Lake water from small drift lake..............	.22	.00	Distinct	.014	.012	.18

CHEMICAL EXAMINATION OF WATER FROM KILKENNY.

1158	Dr. MacDonald..	Village well, 165 ft. deep	.11	.00	Trace ..	.004	.003	.10
1159	" ...	Mr. Gardner's well, 18 ft. deep....................	10.4	Marked	Strong .	.003	.002	.14
1160	" ...	P. D. Bryne's well, 30 ft. deep....................	15.75	"	"	.003	.002	.12
1161	" ...	Mrs. Canarie's well, 20 ft. deep....................	19.17	Distinct	"	.003	.004	.12

CHEMICAL EXAMINATION OF WATER FROM PRESTON.

1162 (a)	Dr. Love.........	Well 150 ft. deep.........	.63	Marked	Distinct	.002	.002	.11

CHEMICAL EXAMINATION OF WATER FROM HENDRICKS.

1163	J. M. Walker....	Village well works 16 ft. deep....................	.15	Absent.	Absent.	.039	.027	.16

CHEMICAL EXAMINATION OF WATER FROM HALLOCK.

1164	Dr. J. B. Muir....	Ravine of Pete Swanson	1.6	Absent.	Trace ..	.039	.027	.16

CHEMICAL EXAMINATION OF WATER FROM FARIBAULT.

1165	R. A. Milligan...	Dug well 45 ft. deep.....	.63	Trace...	Strong	.004	.006	.504

CHEMICAL EXAMINATION OF WATER FROM JASPER.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia. Free.	Ammonia. Albuminoid.	Consumed Oxygen.
1166	Dr. J. H. Bong...	Spring, piped into well 23 ft. deep..............	.4	Trace .	Strong.	None	.001	.22

CHEMICAL EXAMINATION OF WATER FROM EDEN VALLEY.

1167	Mr. Wilson.......	Dug well at rear of Mr. Murphy's..............	1.1	Marked	Strong .	.002	.004	.14
1168	"	Dug well at hotel........	1.0	Trace ..	"	.002	.003	.11

CHEMICAL EXAMINATION OF WATER FROM WINONA.

1169	C. B. Morey......	Driven well 60 ft. deep..	2.0	.00	V. str'g	.005	.005	.12

CHEMICAL EXAMINATION OF WATER FROM EVELETH.

1170	Dr. C. W. More..	Public tap...............	.25	Absent.	Distinct	.002	.006	.312
1171	" ..	Sump in Adams mine...	.30	Trace ..	Marked	.008	.002	.150
1172	" ..	A small creek, previous village supply.........	.20	Absent.	Trace ..	.002	.030	1.99

CHEMICAL EXAMINATION OF WATER FROM ANOKA.

1173	H. C. Carel.......	Rum river taken above hospital for insane.....	.09	.00	.00	.003	.003	.36
1174	"	Rum river from sewage area of hosp. for insane	.27	Trace ..	S. trace	.007	.019	.37
1175	"	Rum river over intake pipe.....................	.27	S. trace	"	.005	.014	.35

CHEMICAL EXAMINATION OF WATER FROM STEWARTVILLE.

1176	Dr. F. W. Burnes	Driven well 65 ft. deep..	.27	.00	.00	.004	.001	.08

CHEMICAL EXAMINATION OF WATER FROM ST. LOUIS PARK.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Collected by	Source.	Chlorine.	Nitrites.	Nitrates.	Ammonia. Free.	Ammonia. Albuminoid.	Consumed Oxygen.
1177	H. C. Carel	Minnehaha creek above dr. from Minn.Sug.Co.	.09	.00	.00	.010	.026	.86
1178	"	Minnehaha cr. 100 ft. below drn. of Minn. S.Co.	.09	.00	.00	.009	.027	.94
1179	"	Drain of Minn. Sug. Co..	.09	.00	.00	.010	.027	.98
1180	"	Minnehaha cr. at bridge of Electric R. R. Co....	.09	.00	.00	.010	.026	.92
1190	"	Minnehaha creek 100 ft. above drain............	.075	Absent.	S. trace	.003	.026	......
1191	"	Minnehaha cr. 300 yds. below M. S. Co.'s drain	.075	Trace ..	"	.005	.029	......

CHEMICAL EXAMINATION OF WATER FROM DETROIT.

1181	Mr. McCart......	Mrs. Furbe's dug well.	.60	S. trace	Strong.	.004	.003	.10
1182	"	Mrs. F. S. Day's dug well	2.1	Marked	"	.012	.007	.12

CHEMICAL EXAMINATION OF WATER FROM ELY.

1183	Dr. C. G. Shipman	Village tap............	.360	.00	Strong..	.001	.008	.09
1184	"	Spring affording village supply.................	.3115	.00	"	.001	.008	.08
1185	"	Village reservoir and well 50 ft. deep.........	.10	Trace...	"	.008	.011	.92
1186	"	Long lake, 80 ft. deep at point taken...........	.10	.00	.00	.009	.012	.97

CHEMICAL EXAMINATION OF WATER FROM BRICELYN.

1162 (b)	Dr. Wesbrook....	Lyng and Wilcox well, 150 ft..................	12.78	Trace ..	Strong.	.006	.024	.18
1186 (b)	Dr. Nannestad...	Town well 114 feet deep....................	.72	"	Marked	.005	.002	.14
1187	"	W. W. Reed's well.......	.27	Absent.	Trace ..	.022	.004	.12
1188	"	A. E. Wilcox, well.......	7.83	S. trace	Distinct	.030	.005	.12
1189	"	Fink & Linderman's	.27	Trace...	Strong.	.001	.046	.16

CHEMICAL EXAMINATION OF WATER FROM MONTEVIDEO.

1192	Dr. Rogers........	Large springs near Montevideo...........	.36	Absent.	Marked	.009	.003	.07

CHEMICAL EXAMINATION OF WATER FROM LAKE MINNETONKA.

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Specimen Taken From	Depth.	Temperature.	Chlorine.	Nitrites.	Nitrates.	Ammonia Free.	Ammonia Albuminoid.	Consumed Oxygen.
1193	Gray's outlet, 100 yds. off Dr. Paul's....................	2	22.5	.0625	Absent.	Distinct	.005	.033	.99
1194	Center Gray's outlet..........	8	21.5	.0625	“	Absent.	.005	.028	1.067
1195	Wayzata Bay, 700 ft. off draw-bridge........................	15	21.	.075	“	Trace ..	.0015	.014	.914
1196	Wayzata Bay, bet. Northland Inn and Cedar Pt......	25	21.5	.075	“	Absent.	.0035	.012	.792
1197	As above......................	4	21.75	.0625	“	Trace ..	.001	.019	.737
1198	Wayzata Bay, ⅛ bet. Wayzata and Cedar Pt...........	25	21.5	.075	“	Distinct	.0025	.019	.825
1199	As above......	4	22.5	.075	“	Absent.	.001	.017	.781
1200	End of Wayzata Dock.........	4	23.	.075	“	S. trace	.0051	.015	.770
1201	Wayzata Bay, 200 ft. off Breezy Club.......	10	22.	.075	“	Trace...	none	.0145	.528
1202	Half way bet. Breezy Pt. and Point Lookout...............	25	22.	.075	“	“	.0005	.0125	.605
1203	As above.................	4	22.5	.075	“	“	.00025	.0105	.594
1204	200 ft. off the F. Peary shore at inlet from small lake........	10	22.2	.0625	“	“	.0005	.0085	.55
1205	Orono Shore in Homoson Brown's Bay, 300 ft. off shore	......	......	.075	“	“	none	.009	.560
1206	Brown's Bay, bet. Lookout Pt. and Orono Bay...............	25	21.	.0625	“	“	0005	.009	.473
1207	As above......................	4	21.2	.075	“	“	.001	.011	.495
1208	Brown's Bay, 600 ft. off Dunwoody Cottage..............	10	22.	.0625	“	“	none	.011	.550
1209	Between Robinson's Bay and Orono Point.................	50	22.	.075	“	“	.005	.007	.440
1210	As above.......................	5	21.2	....	....	....	......	......	......
1211	Middle of Robinson's Bay, 800 yds. off shore................	25	21.	.075	Absent.	Trace +	.0005	.019	.517
1212	As above........	5	21.2	.075	“	S. trace	.001	.015	.616
1213	Between Yacht Club and Ice Yacht Club Islands..........	15	21.	.075	“	Trace +	.001	.015	.550
1214	Deep Haven in middle of Carlson's Bay...............	10	20.5	.075	“	Distinct	.0005	.018	.583
1215	Hotel St. Louis intake pipe, 100 ft. off shore............	5	20.5	.075	“	Trace...	.0005	.018	.583
1216	S. E. of Big Is. bet. Crown and Morris Points................	10	21.	.075	“	“	.0005	.017	.605
1217	Between Crown Pt. and Meadville Park..............	50	20.5	.075	“	“	.01	.017	.482
1218	As above......................	5	21.	.075	“	“	none	.015	.583
1219	End of Excelsior Dock.........	5	22.	.1880	Distinct	“	.0005	.017	.627
1220	Middle of Excelsior Bay, bet. bathing beach and Meadville	10	22.	.1880	Abs. tr.	S. trace	none	.014	.715
1221	Middle of Gideon's Bay.......	25	21.	.0880	Absent.	Absent.	.0005	.0125	.605
1222	Intake of Lake Park Hotel, 75 ft. from dancing pavilion...	4	21.5	.10	“	Distinct	.0005	.023	.550
1223	Between Lake Park intake and Echo Bay Reef..........	25	21.	.10	“	Trace ..	.0005	.021	.550
1224	Between Bayview Pt. and D. M. Clough's..................	15	21.	.10	“	“	.0005	.023	.572
1225	Lafayette Bay, 1,000 ft. off Dock......	20	21.	.0880	“	S. trace	.0041	.019	.526
1226	Smith's Bay, bet. Searle's and Ripley cottages..............	25	21.	.10	“	Trace ..	.001	.025	.594
1227	Between Orono Pt. and Huntington Pt.............	25	......	.075	“	“	none	.020	.627
1228	As above..............	5	......	.075	“	“	.002	.020	.627
1229	Near center of Smith's Bay...	5	......	.010	“	S. trace	none	.0165	.594
1230	Crystal Bay, bet. reef and Norenburg cottage..........	75	20.	.0875	“	Trace ..	.008	.0160	......
1231	As above......................	......	21.	.0625	“	Distinct	.001	.0145	.605
1232	Crystal Bay, 300 ft. off channel to West arm............	10	20.5	.075	“	“	none	.030	.726
1233	West arm, bet. Fagerness settlement and Deering's Isl'd.	10	21.	.075	“	“	.002	.033	...

CHEMICAL EXAMINATION OF WATER FROM LAKE MINNETONKA —*Continued.*

ANALYTICAL DATA IN PARTS PER 100,000.

Laboratory Number.	Specimen Taken From	Depth.	Temperature	Chlorine.	Nitrites.	Nitrates.	Ammonia Free.	Ammonia Albuminoid.	Consumed Oxygen.
1234	West arm, bet. Haugen's farm and Berquist and Wicklund Park........................	10	21.	.0625	Absent.	Trace..	.011	.056	1.265
1235	Middle of North Arm.........	3	21.5	.075	"	"	.001	.030	.726
1236	Maxwell's Bay, 1,500 ft. off Joel Stubbs'................	25	22.	.0625	Trace...	Distinct	.0030	.030	.550
1237	Maxwell's Bay................	5	22.5	.075	Absent.	"	.0005	.034	.770
1238	Center of Stubbs' Bay.........	10	22.5	.075	"	S. trace	.014	.036	.880
1239	Middle of New Narrows......	10	22.	.075	"	Distinct	.0005	.013	.605
1240	S. E. of Narrows in Upper Lk., 500 ft. off old channel........	25	21.	.0625	"	Trace..	.004	.013	.572
1241	Middle of Carmen's Bay.......	10	21.5	.075	"	"	.006	.013	.605
1242	Between Wildhurst and Casco Point.................	25	21.5	.0625	"	"	.004	.019	.583
1243	Wildhurst, bet. Simpson and Wilcox cottage docks........	5	21.5	.0625	"	"	.001	.019	.715
1244	Birch Bluff, 200 ft. off shore...	10	21.5	.0625	"	"	.002	.025	.660
1245	200 ft. off Edgewood dock.....	5	21.5	.075	"	"	.001	.019	.704
1246	Between Shady Isle and Howard Point....................	10	21.5	.075	"	"	.002	.019	.704
1247	Half way bet. Spray Island and Casco...................	25	21.	.075	"	"	.010	.019	.550
1248	Del Otero Hotel intake pipe in Spring Pk. Bay, 125 ft. off s.	10	21.5	.075	"	"	.003	.019	.627
1249	Spring Pk. Bay, 200 ft. off Woolnough Dock............	5	21.5	.0625	"	"	.001	.019	.638
1250	Philips' Bay, middle of entrance.......................	25	21.5	.0625	"	"	.0285	.019	.627
1251	Bet. A. B. Rugo's and Enchanted Is. on main upper L.	25	21.	.075	"	"	.002	.013	.627
1252	Smithtown Bay, 2,000 ft. from Minnetonka Heights........	65	21.	.0625	"	"	.0245	.019	.660
1253	As above......................	5	21.5	.075	"	"	.001	.014	.605
1254	Zumbra Bay, 200 ft. off R. W. Croft's.....................	10	21.5	.075	"	"	.001	.021	.693
1255	Main Upper Lake, 500 ft. off Loring dock................	20	21.	.075	"	"	.004	.021	.649
1256	2,000 ft. off north shore of Crane Island................	65	20.	.075	"	"	.0033	.019	.649
1257	Enchanted Isle., 500 ft. off C. A. Zimmerman's dock......	25	21.	.075	"	Distinct	.001	.016	.572
1258	Middle of Cook's Bay..........	15	21.2	.075	"	S. trace	.001	.016	.616
1259	Bet. docks of Bartlett and Chapman Hotels, 200 ft. out.	5	21.5	.075	"	"	.001	.016	.636
1260	Middle of Halsted's Bay.......	10	21.5	.075	"	"	·001	.091	1.72

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REPORT

OF THE

VETERINARY DEPARTMENT

OF THE

MINNESOTA

STATE BOARD OF HEALTH. and

Vital Statistics

Report AUGUST 1, 1900, TO MAY 1, 1903.

BY

S. D. BRIMHALL, V. M. D., - - - Director of the Department.
F. F. WESBROOK, M. D., - - Director of the Laboratory.
H. M. BRACKEN, M. D., - - Secretary and Executive Officer.

ST. PAUL, MINN.:
THE PIONEER PRESS COMPANY.
1903.

Office of the State Board of Health,
St. Paul, Minn., July 31, 1903.

To His Excellency Samuel R. Van Sant, Governor:

The State Board of Health herewith respectfully submits its report upon the veterinary work of the Board from Aug. 1, 1900, to April 22, 1903.

During this period the Veterinary Department of the Board was under the directorship of Dr. S. D. Brimhall. He was ably assisted by Dr. J. G. Annand, field veterinarian.

The Bacteriological Laboratory of the Board, under the directorship of Dr. F. F. Wesbrook, rendered valuable service in the study of animal diseases, as shown throughout the entire report. It is worthy of note that the Bacteriological Laboratory was seldom called upon to join in the study of animal diseases, until Dr. Brimhall became director of the Veterinary Department. Undoubtedly, Dr. Brimhall's experience as field veterinarian, prior to his directorship, emphasized the necessity of collaboration with the laboratory, both in field and experimental work. The economic results of such joint action are shown throughout this report. They are far reaching and of great financial value.

H. M. BRACKEN, M. D.,
Secretary and Executive Officer.

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W. J. POMPLUN..................................Inspector

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DR. O. McDANIEL.............Second Assistant Bacteriologist

DR. E. H. BECKMAN...........Third Assistant Bacteriologist

MRS. M. I. ROGERS.........Registering Clerk and Stenographer

LEONARD NELSON...................Laboratory Attendant

J. C. CLARK.........Care Taker Laboratory of Animal Research

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ERRATA.

Page 84, line 25—Wolden should read Walden.
Page 96, line 3—Candota should read Kandota.
Page 129, last line—Add "except in rabbit No. 440."
Page 137, line 1—Lyon should read Redwood.
Page 138, line 18—Mycotic Stomatitis should read "Mycotic Apthous Fever."
Page 139, line 16—Conway of Ohio should read Connaway of Columbia, Mo.
Page 139, line 17—Mycotic Stomatitis should read "Mycotic Apthous Fever."
Page 150, line 7,—Barden township, Carver county, should read Barden, Scott county.
Page 179, lines 10, 11 and 12 should be at bottom of page 195.
Page 194, line 37—Dakota should read Washington.
Page 278, line 34—Colt should read case.
Page 313, line 23—Strongulus should read strongylus.
Page 319, line 19—strongulus should read strongylus.
Page 335, line 31—Mesenteric should read mesentery.
Page 374, lines 16 and 17—No. —, should be omitted.

REPORT

OF THE

VETERINARY DEPARTMENT

OF THE

MINNESOTA STATE BOARD OF HEALTH.

INTRODUCTION.

This report should appear as covering the period from Aug. 1, 1900, to Aug. 1, 1902, and as a part of the nineteenth report of the State Board of Health and Vital Statistics. The last legislature saw fit to create a new department to care for infectious diseases of animals, under the title of *State Live Stock Sanitary Board.* It has therefore been deemed advisable to make this the final report of the work upon infectious diseases of animals by the Minnesota State Board of Health.

The care of infectious diseases of animals was placed under the State Board of Health in 1885. These as well as infectious diseases of man were under the control of the secretary, Dr. C. N. Hewitt, until 1897, at which time Dr. M. H. Reynolds, a veterinarian, was made a member of the State Board of Health. Infectious diseases of animals were at once placed under his direction: First, as chairman of the committee having charge of infectious diseases of animals, and later as director of the Veterinary Department. The work continued under Dr. Reynolds' care until August, 1900, a period covering a little more than three and one-half years. During this period the Veterinary Department of the Minnesota State Board of Health was located at the Agricultural Experiment Station, St. Anthony Park.

Gov. John Lind took the position that all departments of the State Board of Health should be located at one and the same place. It was therefore decided early in 1900 to move the Veterinary Department of the Board to St. Paul, and this change was made the first of August of that year.

Governor Lind also took the position that it was unwise for a Board to appoint its own members as directors of departments, and in his reappointment of Dr. Reynolds as a member of the Board in 1900, he made it a condition that he should no longer hold the directorship of the Veterinary Department.

After the removal of the Veterinary Department to the offices of the Minnesota State Board of Health, St. Paul, the work was conducted by Dr. S. D. Brimhall, first, as field veterinarian, Dr. Reynolds still holding an advisory position in the work pertaining to this department.

At the regular quarterly meeting of the Board, April, 1901, it was proposed to make Dr. Brimhall director of this department, but there being one dissenting vote no action was taken. At the July meeting of the same year, Dr. Brimhall was made director of the department and continued to hold this position until its demise upon the creation of the State Live Stock Sanitary Board, April 23, 1903. Under his directorship this work was most ably carried on, covering not only the clinical study of infectious diseases of animals and their care, but the laboratory investigation of such diseases in conjuction with Dr. F. F. Wesbrook, director of the Laboratory of the Board. The importance of studying infectious diseases of animals and of man in the same laboratory and under the control of the same board was fully appreciated and the fact was recognized that many of these diseases are transmissible from animal to man, and vice versa.

In addition to his office duties Dr. Brimhall gave much time to visiting outbreaks of animal diseases, either alone or in company with a representative from the Laboratory. The good work resulting from such investigations must be studied under the records of the various diseases covered in this report. In addition to this local work Dr. Brimhall took steps to keep himself posted on possible invasions from other sections of the country, having visited the New England states at the time of the "*foot and mouth disease*" in that section; also having visited neighboring states from time to time in order to learn the extent of danger from glanders, anthrax, etc.

The excellent work of Dr. Annand must not be overlooked

in these introductory remarks. His time was fully occupied as field veterinarian in watching hog cholera, especially during the season of its greatest prevalence, and also in looking after glanders, bovine tuberculosis and other animal diseases throughout the state. His manner of dealing with sanitary officials with whom he came in contact, as also with the owners of diseased stock, was most satisfactory.

Mr. W. J. Pomplun acted as sanitary inspector for the Board, in looking after the quarantined cows condemned through the tuberculin test by the local health authorities in St. Paul and Minneapolis.

The clerical work of this department was ably cared for by Miss Nellie Carroll, who served as stenographer and clerk during the entire directorship of both Drs. Reynolds and Brimhall. The laboratory work connected with the study of infectious diseases of animals during Dr. Brimhall's directorship is not equalled in any state in the Union. This was under the supervision of Dr. F. F. Wesbrook who was ably assisted by Drs. L. B. Wilson, O. McDaniel, and E. H. Beckman. After the construction of the building devoted to animal research on the University campus, in 1902, the opportunities for carrying on both the routine and research study of animal diseases through the State Board of Health Laboratory were of the best. This work was practically discontinued when the new Live Stock Sanitary Board came into existence.

That this new Live Stock Board appreciated the workers employed by the State Board of Health in its dealing with infectious diseases of animals is shown by the fact that Dr. Brimhall, Miss Carroll and Mr. Pomplun were transferred from the work of the old to that of the new Board.

In making a final report of the laboratory work of the Minnesota State Board of Health in connection with infectious diseases of animals, it may be well to give a short general statement of the problems which arose, and of the methods utilized in their solution.

Immediately upon the permanent establishment of the laboratory in 1896, specimens and requests for investigation came in from all portions of the state. Throughout the history of the laboratory there has been considerable misconception relative to possibilities for satisfactory examination although every attempt has been made to define the limits of such possibility. It has often happened that the first information received by the State Board of Health concerning disease in animals has been through the forwarding of specimens to the laboratory. In comparatively few of the infec-

tious diseases to which animals are susceptible can information of any great value be derived from a laboratory examination of specimens, unless fullest information concerning the conditions obtaining is furnished at the same time.

Frequently a bottle or jar of partially decomposed tissue is forwarded to the laboratory with a note from the owner of the stock, the local health officer who may or may not be a physician, or sometimes a veterinarian. It has happened in more than one instance that materials have been received without any data whatever other than that afforded by the express companies, who were able to give the addresses of the senders.

In the study of material of this kind, it is easily apparent that very much valuable time may be wasted and no practical results obtained owing to the masking or killing out of the infective organism by the putrefactive or other bacteria which have been introduced and developed during collection and shipment. Preservatives too, are sometimes added, thus killing all bacteria. To meet these and kindred difficulties which may be easily imagined, early in the work a circular of information was prepared in which the objects for which the laboratory was established were set forth and general and specific directions given for the collection and sending of specimens.

So far as possible, the endeavor was made to undertake work in infectious diseases of animals only in collaboration with the Director of the Veterinary Department of the State Board of Health. In the reports given under the various headings in the following pages of this volume, there will be found relatively few instances of satisfactory laboratory investigation of materials forwarded to the laboratory, owing to the fact that special knowledge is necessary before materials can be satisfactorily collected and shipped and the requisite data furnished.

In other states where dependence is placed upon such methods, the experience has been similar and no better way for hampering the acquirement of knowledge can be hit upon than the attempt at such long range work. As a contrast to results obtained by such methods, one has only to glance at the work in hæmorrhagic septicæmia, cerebro-spinal meningitis, swamp fever and certain isolated investigations of anthrax, rabies, etc. The reason for the difference in the results obtained is attributable to the fact that some representative of the laboratory went out into the field so as to begin the investigation with a competent veterinarian at the proper point. In such investigations, the necessary apparatus and supplies were

taken from the laboratory so that fresh and preserved microscopic and macroscopic specimens of tissues and fluids might be properly collected, and, if necessary, examined immediately. Cultures were made and data collected before post mortem changes masked the disease processes. (See page 451, Biennial Report, State Board of Health, 1899-1900.) Materials collected by representatives from the Veterinary Department and the laboratory were brought to the laboratory and the studies there completed.

In the investigation of any new or obscure disease, of necessity very much more time is consumed in making the first few examinations than is required for the later cases. Methods are elaborated which conduce to rapidity of work and, furthermore, the observer knows the problem which is before him.

It is quite often impossible to explain satisfactorily to the senders of specimens or those who are anxious for a laboratory investigation, the probable futility of obtaining satisfactory results, nor has it been generally understood that the investigations of the State Board of Health are for the purpose of diagnosing infectious diseases in order that their sources be exactly located and eradicated.

Requests have frequently been made for examination of single cases of sickness in animals or of supposed peculiarities in animal food products, in which no history could be obtained tending to show that the health of man or a number of animals was jeopardized.

Individuals are sometimes ready to ask that many dollars' worth of time and work be given in order to satisfy curiosity or to determine whether the carcass of a single animal is fit for food because the state's money pays for it.

So far as possible, during recent years, attempt has been made to investigate only such diseases as appear to be infectious and those, too, which were threatening to become widespread.

Wherever possible a representative of the bacteriological laboratory accompanied the representative of the Veterinary Department in the investigation of diseases where the laboratory could be of service. In the work on hæmorrhagic septicæmia, swamp fever in horses, cerebro-spinal meningitis, malignant catarrh in cattle and other such diseases, micro-organisms had been isolated from many cases but no facilities existed for the testing of the pathogenesis of the bacteria which had been kept under cultivation and observation. The erection of the Laboratory of Animal Research, completed in the fall of 1902, permitted of the undertaking of this work

and attempt has been made to reproduce certain of these diseases by inoculation and feeding experiments in order that prophylactic and curative measures might be instituted. This work could not be brought to a satisfactory conclusion however, owing to the removal of this branch of the work from the control of the State Board of Health in April, 1903.

During 1901-1902, one member of the laboratory force has been continually working on diseases of animals and when special opportunities arose for the investigation of some problem or when demand occurred, the whole laboratory staff was employed on animal disease, due care being taken not to jeopardize the routine work in human disease. Research problems which could be laid aside without harm, were temporarily abandoned for emergency calls in animal investigations.

Much more could have been accomplished were it not for the fact that many calls came for laboratory time and energy to be spent upon materials forwarded to the laboratory for investigation in which there seemed little hope of satisfactory results being obtained. These might well have been ignored in most instances but the fear that opportunity for ascertaining important facts might be lost or that offense might be given to those who had interested themselves in these matters, led to the waste of a very great deal of time without commensurate results. Such risks must be taken by any board interesting itself in this kind of work unless it be possible to answer every call immediately, by the sending of veterinary and laboratory representatives who may frequently find that there is no necessity for any investigation. The traveling expenses of such representatives. however, will be more than offset by the saving of time required in examining valueless specimens and acquiring useless data.

LEGISLATION.

During the legislative session of 1901, a bill was presented by Mr. N. K. Hunt of St. Cloud looking to the removal of infectious diseases of animals from the State Board of Health. Bearing upon this subject a conference was held March 31, 1901, at which was present Senator R. B. Brower, Representatives N. K. Hunt and A. K. Bush, Drs. J. C. Currier, F. D. Ketchum, C. C. Lyford, Richard Price, S. D. Brimhall and J. G. Annand (veterinarians), Mr. N. P. Clark, Mr. Chas. Kenning, Mr. Wm. J. Pomplun, Drs. F. F. Wesbrook, L. B. Wilson of the laboratory and Drs. H. Hutchinson, E.

Shumpik, M. H. Reynolds and H. M. Bracken of the State Board of Health. The Hunt bill was discussed. Its chief point was to establish a live stock commission to consist of three live stock breeders and one veterinarian. After thoroughly considering the subject as to whether infectious diseases of animals should still be left under the State Board of Health or should be placed under such a live stock commissioner as that proposed in the Hunt bill, it was decided to favor the enlargement by legislative act of the present State Board of Health, leaving the infectious diseases of animals still under its control. Dr. Henry Hutchinson, chairman of the conference, was authorized to appoint a committee consisting of three to carry out this plan. Senator Brower, Rrepresentative Bush and Dr. Ketchum were named upon the committee. Neither Senator Brower nor Representative Bush felt that they could well serve in this capacity. Representative Hunt and Dr. Bracken were appointed to serve in their stead. Dr. Bracken expressed his unwillingness to serve on the committee and requested that Dr. Hutchinson should serve in his place, and the request was granted. Mr. Hunt expressed his willingness to withdraw his bill provided the points in which he was interested were covered by the State Board of Health. Mr. Clark, at this time, expressed himself as dissatisfied with veterinarians and their methods of dealing with infectious diseases of animals, judging from a sanitary standpoint. At this conference both Drs. Currier and Reynolds presented certain points which they considered important in the reorganization of this work. On March 14th these points were taken up by the Executive Committee of the State Board of Health, consisting of Drs. Hutchinson, Reynolds and Bracken, with Mr. Harris Richardson (the Board's attorney), at which time it was deemed advisable to make the following recommendation:

First: That the State Board of Health should have in its membership one veterinarian and two stockmen;

Second: That the State Board of Health should have power to appoint a director of the bacteriological department, a director of the veterinary department and a director, or directors, of such other department, or departments, as may in the future be created, such directors to be chosen annually by the board, but not to be members of the board;

Third: That the director of each department should have charge of all correspondence connected directly with his department, and should examine and approve all bills, both for services and materials used in his department and forward the same at the

end of each month to the secretary and executive officer of the Board, to be passed upon as prescribed by the law;

Fourth: That the director of each department should submit a quarterly report to the State Board of Health; that he should also suggest to the board for its endorsement, modification or rejection, rules and regulations which he might consider necessary for the proper working of his department;

Fifth: That the State Board of Health should make such rules and regulations for its departments as it might deem necessary.

These recommendations seemed to cover all the points suggested by Dr. Currier the preceding evening, except that but one veterinarian instead of two was called for upon the board, and that the appointments were to be left entirely in the hands of the Governor, as was the case in the appointments of the present members of the board. (Dr. Currier had suggested two veterinarians and two stockmen, the latter to be *nominated by the State Stock Breeders' Association*, to be placed upon the Minnesota State Board of Health by the Governor.) The points presented by Dr. Reynolds were also discussed. Several of these were practically embodied in the suggestions for the new law, while others were considered impractical from a legal point of view. On March 15, Representative Hunt, Drs. Ketchum and Hutchinson, the committee appointed at the Conference meeting to consider the points that had been gone over with Mr. Richardson on the previous day, met. Dr. Bracken was present by request. As a result of this Committee meeting, the following amendment was made to the General Sanitary bill that was already before the Legislature, Mr. Hunt withdrawing his bill calling for the creation of a sanitary live stock commission: First, "The first two vacancies which occur on the State Board (of Health), after the passage of this act, shall be filled by appointment of practical stockmen, and thereafter said board shall at all times be so constituted as to have thereon at least one competent veterinarian and two stockmen. Said board shall have an executive committee. There shall always be one veterinarian and at least one stockman on said committee. There shall be a Veterinary Department, a Bacteriological Department, and such other departments as the board may from time to time create. The Veterinary Department shall be in charge of a director who shall be a competent veterinarian, and who shall not be a member of the Board. The Bacteriological Department shall be in charge of a director, who shall be a competent bacteriolo-

gist, and shall not be a member of the board. The directors of other departments shall not be members of the board. The directors of the board shall be appointed at the meeting of the board in January of each year."

Unfortunately, certain parties who had attended the conference already referred to were not satisfied with this wording. In the conference it had been agreed to abide by the action of its committee. In spite of this agreement, however, a "rider" was put upon the above amendment which materially altered its character. This "rider" caused much discussion in the Committee on Public Health in the House and resulted eventually in the death of the entire sanitary bill, including this special feature, in the committee of the House.

During the Legislature of 1903 a bill, formulated by the State Board of Health, was introduced, looking to the correction of sources of hardships in the compensation provided to owners of cattle that had been slaughtered because of tuberculosis, and also providing compensation to owners of glandered horses destroyed on account of that disease. This was known as the Krostue bill. It read as follows:

CHAPTER 141—LAWS OF 1903.

"An Act to Prevent the Spread of Contagious and Infectious Diseases Among Domestic Animals in this State."

Be it enacted by the Legislature of the State of Minnesota:

Section 1. That section four (4) of chapter two hundred and thirty-three (233) of the General Laws of 1897, as amended by chapter three hundred and twenty-two (322) of the General Laws of 1901, be and the same is hereby amended so as to read as follows:

Section 4. No animal shall be killed by any of the boards of health herein mentioned until it shall first have been adjudged to be infected with a contagious or infectious disease either by a duly authorized agent of the state board of health, or by a competent veterinary surgeon selected by a local health officer or board of health; except, that, whenever, in the judgment of the state board of health, the control or eradication of a disease renders it advisable to do so, such board may order killed and buried, or otherwise destroyed, any domestic animal which has been exposed to a contagious or infectious disease, although at the time not infected therewith.

Provided, however, that cattle in this state shall not be adjudged infected with the disease of tuberculosis or condemned as

being so infected, and that horses in this state shall not be adjudged infected with the disease of glanders or condemned as being so infected except and until such animal has been inspected by a competent veterinarian under the authority of the state board of health.

Sec. 2. That section five (5) of chapter two hundred and thirty-three (233) of the General Laws of 1897, as amended by chapter three hundred and twenty-two of the General Laws of 1901, be and the same is hereby amended so as to read as follows:

Section 5. Whenever a domestic animal has been adjudged to be infected with a contagious or infectious disease and has been ordered killed, the owner or keeper of such animal shall be notified thereof, and within twenty-four (24) hours thereafter he may file a written protest with the board of health which is responsible for such killing, against the killing thereof, and shall therein state under oath that to the best of his belief such animal is not infected with any contagious or infectious disease. Whereupon such animal being killed notwithstanding such report, a post mortem examination thereof shall be made by experts who shall be present at the killing and shall be appointed one by the board of health, or its representative, which ordered the killing, one by the owner or keeper, and one by the two already appointed, and if upon such examination said animal shall be found to have been entirely free from contagious or infectious disease they shall also appraise it at its cash value immediately before it was killed, and the amount of such appraisal shall be paid to the person entitled thereto out of the funds of the state or the municipality ordering the killing. The experts shall be paid one-half by the owner or keeper making the protest and one-half by the state or municipality whose board of health is responsible for the killing. In case the owner or keeper of such animal shall fail to appoint in writing at the time, an expert as herein provided, an expert shall be appointed by the state board of health or its representative in lieu of the one provided herein by the owner or keeper. All appraisements and examinations made under this act shall be in writing, signed by the appraisers or examiners, certified to by the Board of Health ordering the examination or killing, and filed with the treasurer of the state or of the municipality which is responsible for the examination or killing. Upon the filing of any such examination as appraisal it shall be the duty of the Board of Health which is responsible for the examination or killing to make a certificate under the hand of its secretary as to the number of days served by and the amount due to said ex-

perts or appraisers and to file the same with the treasurer of the state or municipality, as the case may be, which is responsible for the examination or killing, and upon such filing, such treasurer shall pay to each of said experts or appraisers the amount due him, and to the person entitled thereto the amount due him by the terms hereof; provided, however, that any expert or appraiser employed on a salary by the Board of Health shall receive no compensation hereunder. Whenever any domestic animal has been adjudged infected with the disease of tuberculosis or glanders and has been ordered killed by a duly authorized representative of the State Board of Health and is killed in accordance therewith after or without protest, the value of such animal shall be determined by a board of appraisers consisting of three competent and disinterested men, one to be appointed by the State Board of Health or its representative, one by the owner or keeper of the condemned animal, within twenty-four (24) hours after the killing is ordered and the third by the two already appointed, who shall appraise it, before it is killed, at its cash value, provided, that in determining such value the fact that such animal was infected by tuberculosis or glanders shall not be taken into consideration, and provided further that in no case shall the appraised value of a horse afflicted with glanders exceed seventy-five (75) dollars, and in no case shall the appraised value of a cow afflicted with tuberculosis exceed thirty-five (35) dollars, and provided that payment shall not be made for any such animal unless such animal is one year old or over, and has been kept in this state in good faith for at least one year next prior to the killing thereof. In case the owner or keeper fails to appoint an appraiser, as herein provided, one shall be appointed on his behalf by the representative of the State Board of Health. The market value of the carcass of the tuberculous animal shall be deducted from the appraised value of the animal, and three-fourths the remainder thereof or three-fourths of the appraised value of the glandered horse shall be paid by the State in the manner hereinbefore set forth to the person entitled thereto who shall bear the remaining one-fourth of the loss. Each appraiser shall receive one (1) dollar a day for his services as appraiser. Whenever any such animal which has been adjudged to be infected is killed by order of said board, but not by the owner or keeper thereof, a post mortem examination thereof shall be made by experts appointed as aforesaid, and if found to have been entirely free from any infectious disease the value of such animal shall be determined, and paid for as hereinbefore specified. Except

as in this section expressly provided, no compensation shall be paid for any animal killed by virtue of any authority given by this act.

Sec. 3. This act shall take effect and be in force from and after its passage.

Approved April 8, 1903.

This, an excellent bill, became a law. The bill which also became a law creating a state live stock sanitary board reads as follows:

(Compare this law with Chapter 233, Laws of 1897, and Chapter 322, Laws of 1901.)

CHAPTER 352—LAWS OF 1903.

Be it enacted by the Legislature of the State of Minnesota:

Section 1. That a board is hereby established to be known as "The State Live Stock Sanitary Board." This board shall consist of five (5) members to be appointed by the governor of the State of Minnesota. Each member of said board shall be a qualified elector of the State of Minnesota. Three members of said board shall be persons who are financially interested in the breeding and maintenance of live stock in the State of Minnesota, and two members of said board shall be competent and qualified veterinary surgeons who are graduates of some regularly organized and recognized veterinary colleges practicing in the State of Minnesota.

Sec. 2. In making the first appointments to said State Live Stock Sanitary Board, the governor shall divide the appointees into five classes: the term of office of each of the first appointees shall commence on the first day of April, 1903; one of said appointees shall hold his office for a term of one year; one for the term of two years; one for the term of three years; one for the term of four years; and one for the term of five years; and at the expiration of the term of office of each of the first appointees, a successor shall be appointed who shall hold his office for a term of five years, so that the term of office of one member of said Board shall expire every year. In case of the death, resignation or removal of any member of said board during his term of office, the governor shall appoint a successor to serve the unexpired portion of the term of office of such member.

Sec. 3. Immediately after the appointment of the first board hereinafter provided for, the members thereof shall meet at the city

of St. Paul, and from their own number shall elect a president and a vice president. They shall also elect, from outside their number, a secretary, who shall be a graduate of some regularly organized and recognized veterinary college, who shall be the executive officer of said board, and who shall receive such compensation as said State Live Stock Sanitary Board may determine. His term of office shall be one year, and he shall hold his office until his successor is elected and qualified. The said board may also, if it deem expedient, elect a field veterinarian, a bacteriologist and an attorney for said board, which said officers, if elected, shall also hold office for the term of one year, and shall receive such compensation as may be determined by said State Live Stock Sanitary Board. The said State Live Stock Sanitary Board shall also have the power to appoint or employ such additional help as it may deem necessary and expedient for carrying into effect the powers and duties conferred on said board by this act.

Sec. 4. No member of said State Live Stock Sanitary Board shall receive any compensation for any services he may render, either as a member of said board, or to said board, under the provisions of this act, save and except that the members of said board shall receive their actual expenses necessarily paid or incurred in the discharge of their duties as members of said board.

Sec. 5. The said State Live Stock Sanitary Board shall hold quarterly meetings in the city of St. Paul, on the Friday after the second Tuesday in January, April, July and October of each year. The annual meeting of said board for the election of officers shall be on the Friday after the second Tuesday in April of each year.

Sec. 6. It shall be the duty of the said State Live Stock Sanitary Board to protect the health of the domestic animals of the state; to determine and employ the most efficient and practical means for the prevention, suppression, control and eradication of dangerous, contagious, and infectious diseases among the domestic animals of the State of Minnesota, and for these purposes it is hereby authorized and empowered to make all such rules and regulations for the conduct of the business of said State Live Stock Sanitary Board as it may deem expedient.

Sec. 7. It is hereby made the duty of the several local boards of health of the towns, villages, and cities of this state to cooperate with and assist said State Live Stock Sanitary Board in all matters and things pertaining to the prevention, suppression, control and eradication of dangerous, contagious or infectious diseases among the domestic animals of the state, whenever directed so to

do by said State Live Stock Sanitary Board or the executive officer thereof, and in such manner as directed by said State Live Stock Sanitary Board.

Sec. 8. All authority conferred upon the State Board of Health by any law of the State of Minnesota concerning the prevention, control, suppression or eradication of contagious or infectious diseases among any of the domestic animals of this state is hereby taken from said State Board of Health and conferred upon said State Live Stock Sanitary Board. The proviso at the end of section four (4) of chapter two hundred and thirty-three (233) of the laws of Minnesota for the year 1897, is hereby repealed.

Sec. 9. Authority is hereby given to the State Live Stock Sanitary Board and to the several local boards of health of the towns, villages and cities of this state, to take all steps they may severally deem necessary to control, suppress and eradicate any and all contagious and infectious diseases among any of the domestic animals in this state, and to that end, said boards are hereby severally empowered, within their respective jurisdictions, to quarantine any domestic animal which is infected with any such disease or which has been exposed to infection therefrom; to kill any animal so infected, and, whenever deemed necessary by the State Live Stock Sanitary Board, to kill any animal which has been exposed to the infection of any such disease; to regulate or prohibit the arrival in or departure from this state, or the arrival in or departure from any of the towns, villages and cities thereof, of any such exposed or infected animal, and at the cost of the owner thereof, to detain any domestic animal found in violation of any such regulation or prohibition; to adopt all such rules and regulations as may be by such several boards deemed necessary or expedient to enforce the authority hereby given; and said State Live Stock Sanitary Board is hereby expressly given authority to regulate or prohibit the shipment into this state of any domestic animal which in the judgment of said board may injure the health of live stock in this state; provided that neither said State Live Stock Sanitary Board nor any local board of health shall, by any rule or regulation thereof, prohibit the sale, disposal or removal of any domestic animal of any person or persons from any place when such animal has no disease or has not been exposed to any contagious disease, and the fact that animals are upon the same premises with other animals having a contagious disease shall not of itself necessarily be construed as evidence of exposure to such a contagious disease as is had by said other animals.

Sec. 10. Any person who knows of or has reason to suspect the existence of any contagious or infectious disease in any domestic animal in the State of Minnesota shall forthwith give notice thereof to the local board of health of the town, village or city wherein such animal is kept. Within twenty-four hours after any local board of health shall receive notice or have knowledge that any domestic animal is infected with any such disease or has been exposed thereto, it shall give notice thereof in writing to the said State Live Stock Sanitary Board.

Sec. 11. All rules and regulations adopted by said State Live Stock Sanitary Board by any local board of health under the authority of this act shall be entered upon the minutes of the board so adopting such rules or regulations and shall be published in a newspaper to be designated by the board making such rule or regulation and in the manner by such rule or regulation prescribed. All regulations now in force adopted by any board of health within this state under authority of any law existing prior to the passage of this act or relating to the matters covered by this act and not in conflict with this law, are continued in force and are hereby declared to be rules and regulations of said State Live Stock Sanitary Board and the several local boards of health of the towns, villages and cities under this act until such times as others are adopted.

Sec. 12. No animal shall be killed by any of the boards herein mentioned until it shall first have been adjudged to be infected with a contagious or infectious disease, either by a duly authorized agent of said State Live Stock Sanitary Board or by a veterinary surgeon selected by a local board of health; except that whenever, in the judgment of said State Live Stock Sanitary Board, the control or eradication of the disease renders it advisable to do so, said State Live Stock Sanitary Board may order killed and buried or otherwise destroyed any domestic animal which has been exposed to a contagious or infectious disease although at the time not infected therewith.

Sec. 13. Whenever a domestic animal has been adjudged to be infected with a contagious or infectious disease and has been ordered killed by said State Live Stock Sanitary Board or by a local board of health, the owner or keeper of such animal shall be notified thereof, and within twenty-four hours thereafter such owner or keeper may file a protest against the killing thereof with the board which has ordered such animal killed. Such notice shall state under oath that to the best of the knowledge and belief of the person making such protest, such animal is not infected with any con-

tagious or infectious disease; whereupon if such animal is killed notwithstanding such protest, a post-mortem examination thereof shall be made by three experts, one of said experts to be appointed by said State Live Stock Sanitary Board; one to be appointed by the person making such protest, and the two thus appointed to choose a third.

If upon post-mortem examination such animal shall be found to have been entirely free from contagious or infectious diseases, there shall be appointed three competent and disinterested men, one to be selected by said State Live Stock Sanitary Board, one by the person making such protest, and the third by the two already appointed, to appraise such animal at its cash value immediately before it was killed, and the amount thereof shall be paid to the owner of said animal out of the funds hereby appropriated for the purpose of carrying out this act.

The appraisements made under this act shall be in writing and signed by the appraisers and certified by the local board of health and the said State Live Stock Sanitary Board respectively, to the auditor of the state, who shall draw a warrant on the state treasurer for the amount thereof.

Sec. 14. The expense of the experts in making the post-mortem examination herein provided for shall be defrayed by said State Live Stock Sanitary Board out of the moneys appropriated for the carrying into effect of this act, in case said experts upon examination find such animal to have been entirely free from contagious or infectious disease. If, however, upon such examination, such animal shall be found to have been infected with a contagious or infectious disease, then the expense of the expert appointed by said State Live Stock Sanitary Board and the third expert shall be paid by the said State Live Stock Sanitary Board out of the funds hereby appropriated for the carrying into effect of this act, and the expense of the other expert shall be paid by the person making the protest. The amount of such expense shall be fixed and allowed by the said Live Stock Sanitary Board and by its certificate to the state auditor, who shall draw his warrant on the state treasurer for the amount thereof.

Sec. 15. Upon the filing of any appraisement hereinbefore provided for, it shall be the duty of the local board of health in the town, village or city where such appraisement shall have been had to make a certificate under their hand of the number of days served by the appraisers in making their appraisement, and upon the filing of such certificate, the said certificate shall be forwarded to the

State Live Stock Sanitary Board and if by said board found to be correct, such fact shall be endorsed on the back thereof and such certificate with such endorsement shall be filed with the state auditor and the state treasurer shall pay to each of said appraisers the sum of two dollars per day for his services as such appraiser upon the warrant of the state auditor, such payment to be made out of the funds herein appropriated.

Sec. 16. Whenever any such animal which has not been adjudged to be infected is killed by order of said board, but not by the owner or keeper thereof, a post-mortem examination thereof shall be made by experts appointed as aforesaid, and if found to have been entirely free from any contagious or infectious disease, the value of such animal shall be determined and paid for as hereinbefore specified.

Sec. 17. The expense of the killing and burial, or destruction, of any diseased animal ordered killed by either of the boards aforesaid shall be borne by the town, village or city where such animal was kept. The expense of the quarantine of any infected animal, or of any animal that has been exposed to infection, when taken from the possession of its owner or keeper, shall be borne, one-fifth by the town, village or city where the animal was kept and four-fifths by the state. When any animal is quarantined upon the premises of the owner or keeper, the expense thereof shall be borne by such owner or keeper. Whenever any animal is quarantined when being shipped into the state, the expenses thereof shall be borne by its owner or keeper. Whenever the owner or keeper of any domestic animal is liable for any expense incurred under this act by the State Live Stock Sanitary Board or by any board of health in connection therewith, such board may have a lien on such animal for such expense, and may also maintain an action against such owner or keeper therefor.

Sec. 18. It is hereby made the duty of the several local boards of health in this state to carry out and enforce all orders and directions of the State Live Stock Sanitary Board to them directed, and the State Live Stock Sanitary Board may require any two or more local boards to act together for the purpose of enforcing any of the provisions of this act.

Sec. 19. Whenever the rules and regulations of the State Live Stock Sanitary Board made under authority of this act conflict with the rules and regulations made hereunder by any local board of health, those made by the State Live Stock Sanitary Board shall supersede those made by the local board.

Sec. 20. The State Live Stock Sanitary Board, or any member or duly authorized agent thereof, may examine or cause to be examined, under oath, all persons believed to possess knowledge of material facts concerning the existence or dissemination, or danger of dissemination, of disease among domestic animals; and, for this purpose, shall have all the powers vested in justices of the peace to take depositions and to compel witnesses to attend and testify.

Sec. 21. Any person violating any provisions of this act or any rule or regulation made by the State Live Stock Sanitary Board, or by any local board of health, or any order made by any such board under the authority hereof, shall be guilty of a misdemeanor, and be punished by a fine of not less than twenty-five (25) dollars or more than one hundred dollars, or by imprisonment for not less than thirty (30) days or more than ninety (90) days. Any member of any local board of health who shall neglect or refuse to carry into effect the provisions of this act, or who shall neglect or refuse to carry out any direction of the State Live Stock Sanitary Board, or who shall neglect or refuse to enforce any rule or regulation made by the State Live Stock Sanitary Board, or by any local board of health under the authority hereof, shall be guilty of a misdemeanor and be punished by a fine of not less than twenty-five (25) dollars and not more than one hundred (100) dollars; and each and every day's neglect or refusal to perform any duty imposed upon him by this act shall constitute a separate and independent misdemeanor. Complaints for violating the provisions of this act, or for violating any rule or regulation made by the State Live Stock Sanitary Board or by any board of Health under its authority, or by the said State Live Stock Sanitary Board, may be made by any member or authorized agent of any such board, or by any citizen of this state, or by any person directly interested.

Sec. 22. Whenever, during the prevalence in this state of any contagious or infectious disease among domestic animals, the owner shall post on his premises a notice forbidding all persons not authorized by said State Live Stock Sanitary Board or local boards of health to enter any building or inclosure on said premises without permission from said owner, it shall be a misdemeanor to enter upon said premises, punishable by a fine of not less than twenty-five (25) dollars, nor more than one hundred (100) dollars, or by imprisonment for not less than thirty (30) nor more than ninety ((90) days.

Sec. 23. The said State Live Stock Sanitary Board shall make an annual report to the governor of Minnesota of all its proceed-

ings and transactions for the preceding year, which said report shall be published by the State of Minnesota.

Sec. 24. The State Board of Health is hereby directed to turn over and deliver to said State Live Stock Sanitary Board, immediately upon the appointment of said board, all books, papers, documents and files of said State Board of Health pertaining or relating to contagious or infectious diseases of domestic animals, either in Minnesota or elsewhere.

Sec. 25. The annual appropriation, made for the use of the State Board of Health by the provisions of section twelve (12) of chapter (233) two hundred and thirty-three of the Laws of Minnesota for the year 1897 as amended by section two (2) of chapter three hundred and twenty-two (322) of the Laws of Minnesota for the year 1901, is hereby transferred from said State Board of Health and granted and appropriated to said State Live Stock Sanitary Board for the carrying into effect the purposes of this act; and any moneys which at the time of the passage of this act remain unexpended out of said annual appropriation for the fiscal year ending July 31st, 1903, is hereby transferred from said State Board of Health and granted and appropriated to said State Live Stock Sanitary Board.

Sec. 26. All acts and parts of acts inconsistent with this act are hereby repealed.

Sec. 27. This act shall take effect and be in force from and after its passage.

Approved April 21, 1903.

INFECTIOUS DISEASES OF ANIMALS.

BOVINE TUBERCULOSIS.

In 1897 Minnesota passed a law providing for the condemnation of cattle responding to the tuberculin test. (See Chapter 233.) This law had a clause requiring two tests, however, before any animal could be condemned, the tests to be not less than two or more than three months apart. This proviso was not considered necessary by the veterinarians or sanitarians, but was insisted upon by the dairymen, and was granted by those interested in order to secure the passage of the bill.

This proviso was a great hardship, for it compelled the keeping of cattle that had responded to the first test in quarantine until the second test, and during this period the milk or its products could not be used. There was thus inconvenience and expense without any return. This law continued in force until the passage of the Krostue bill in 1903. (See page—) When the above law went into effect Minneapolis was trying to secure a non-tuberculous milk supply through the use of the tuberculin test. The courts had determined the right of the city to test cattle within the city limits and to exclude milk from the city unless it came from tested herds. The city had no legal right to test cows outside of its jurisdiction, but many dairymen gave the city inspectors permission so to do rather than have their milk excluded from the Minneapolis market. In the fall of 1899 St. Paul began the testing of dairy herds as a means of securing a non-tuberculous milk supply. The Twin Cities had no jurisdiction outside of their limits to establish or maintain quarantine on animals condemned by the tuberculin test. In order to aid in this apparently laudable task the State Board of Health appointed an inspector, Mr. W. J. Pumplum, to act through the various local boards of health (township and village) in the quarantine of condemned animals outside of the cities' jurisdiction. The dairymen were great financial losers through this law, for they received nothing for their condemned cattle. At the same time no provision was made by which they might buy tested cattle; hence after the testing of their herds, with a condemnation of some of the cattle, there

was nothing for them to do but buy other cows of which they had no assurance that they were any better than those just condemned and slaughtered.

In 1901 the legislature passed a bill (Chapter 322) providing compensation to owners of condemned tuberculous animals, the state to pay one-third and the local sanitary district to pay one-third of the appraised valuation of an animal, such appraisal in no instance to exceed forty dollars. This law was of great aid to the dairymen but a burden to the country districts (townships and villages), and in some instances townships were governed in their election of officers by a pledge from the candidates to the effect that they would resist the payment of any such claims against the township. This burden upon the township was removed by the Krostue bill in 1903. (See page 17) Conferences were held from time to time between the State Board of Health and the health commissioners of St. Paul and Minneapolis relative to the best means of securing dairy herds free from animals that would react to the tuberculin test.

In May, 1901, the state officials proposed the establishment of one or more dairy marts in the Twin Cities where tested cows could be purchased. Dairymen had expressed their willingness to pay five dollars more for tested than non-tested cattle. The state could not establish such marts in any sanitary district without the permission of the local authorities for the locality would be responsible for one-third the appraised valuation of the condemned animals. The state officials felt that it would be cheaper for the cities to inspect and condemn infected cows before they went into a herd than to allow them to enter a herd when they might not be inspected within a year after purchase. They also felt that the state could well afford to conduct the testing at such dairy marts without charge. If this proposition had been accepted the city authorities could have given their time and attention to inspection of dairies as to general sanitary conditions—cleanliness, ventilation, care of milk, etc. The city boards of health did nothing towards meeting this proposition.

No material changes were made by the city boards of health, in their methods of testing. Cows were condemned and killed, and others were bought to take the place of those condemned without any assurance that the newly purchased animals were any better than the condemned animals whose place they took. Still further, the dairymen were constantly buying fresh cows to place in their herds. The city testing did not on an average reach any herd oftener than once a year. A dairyman might have very few tested

cattle by the time the inspection reached him. The city milk consumers in the meantime were under the impression that they were purchasing milk from tested cows. As the state was spending quite an amount of money on this testing of cows in and near the Twin Cities it seemed but right that it should take steps to determine what progress was being made. An inspector was sent to the dairies in and near to the Twin Cities. Among other things he was to find out what percentage of the cows in the herd were tested cows at the time of his visit. The result is shown as follows:

	—Percentage of—	
	Tested Cows.	Non-tested Cows.
St. Paul	78	22
Country near St. Paul	59	41
Minneapolis	69	31
Country near Minneapolis	65	35

Taking the city and neighboring country districts for St. Paul and Minneapolis we find the following:

	—Percentage of—	
	Cows Tested.	Cows not Tested.
For St. Paul	68.5	31.5
For Minneapolis	67	33

It will thus be seen that the conditions were much the same for both cities viz.: about two-thirds of the cows in and near the cities were tested and this may be taken as a fair statement of actual conditions.

It must not be overlooked, however, that a large proportion of the milk supplying both cities is shipped in by rail from distant points and from non-tested herds. The amount of milk from tested cows supplied either city is in all probability far below fifty per cent. Thus all this expense of testing cattle, judging from the consumer's standpoint, avails but little. The dairyman, in his own interests, should see that his herd is free from tuberculosis, and he may well use the tuberculin test as a means of so doing. So far as a pure milk supply is concerned it would appear that a close inspection of dairies as to their general condition would accomplish much good. The following table gives some idea of what our inspectors found. The inspection was made in late winter and early spring.

INSPECTION OF DAIRIES.

ST. PAUL.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
1	11	2	fair	milk house	wet	dark, damp.
2	18	6	good	milk house (dirty)	dry	damp, bad air.
3	7	1	fair	milk sold at once	wet	damp, poor ventilation.
4	8	7	fair	milk house	dry	damp, poor ventilation.
5	15	1	fair	milk house	wet	dirty, poor ventilation.
6	15	3	good	tank (dirty)	dry	dark, fair ventilation.
7	18	2	fair	milk house	dirty	damp, poor ventilation.
8	11	3	fair	shed (dirty)	dry	light, bad ventilation.
9	27	0	poor	tank outside	wet	poor generally.
10	9	1	poor	dwelling house	dry	dirty, no ventilation.
11	3	1	fair	sold at once.	wet	fair, no ventilation.
12	6	2	fair	cistern	dry	damp, no ventilation.
13	17	6	fair	milk house	clean	good, well ventilated.
14	18	8	good	milk house	dry	dry, poor ventilation.
15	0	7	poor	milk house	dry	dirty, bad.
16	20	23	fair	milk house	good	fair.
17	8	8	fair	milk house (dirty)	poor	damp, poor ventilation.
18	10	7	dirty	tank (dirty)	wet	bad.
19	19	2	fair	milk house	dirty	poor.
20	11	2	good	milk house	dry	damp, no ventilation.
21	6	2	good	milk house	dry	damp, fair ventilation.
22	18	1	fair	milk house	wet	bad, unsanitary.
23	8	2	fair	shed	dirty	unsanitary.
24	21	1	fair	shed	dry	damp, poor ventilation.
25	14	10	fair	milk house	dry	damp, poor ventilation.
26	18	2	fair	milk house	dry	unsanitary.
27	22	1	fair	milk house	dirty	dry, well ventilated.
28	13	1	dirty	milk house	wet	very unsanitary.
29	13	0	fair	milk house	wet	damp, poor ventilation.
30	12	4	fair	cellar	fair	damp, fair ventilation.
31	22	6	fair	milk house	wet	damp, poor ventilation.
32	12	1	fair	dwelling house	dirty	damp, poor ventilation.
33	18	13	fair	milk house	damp	damp, poor ventilation.
34	14	2	fair	milk house	wet	damp, poor ventilation.
35	16	14	good	milk house	damp	damp, poor ventilation.
36	12	6	good.	milk house	dirty	unsanitary.
37	8	5	poor (dirty)	dirty shed.	good	damp, poor ventilation.
38	11	5	good	cellar	dry	damp, poor ventilation.
39	1	2	dirty	dwelling house	good.	damp, no ventilation.
40	20	5	dirty	milk house	dry	damp, poor ventilation.
41	27	7	fair	outside tank	dry	generally good.
42	10	2	fair	milk house	good	good.
43	11	1	good	milk house	dirty	fairly good.
44	50	2	good	outside tank	dry	good.
45	21	0	dirty	milk house (dirty)	good	poor ventilation.
46	12	6	dirty	outside tank	poor	bad.
47	21	2	fair	milk house	dry	unclean, ventilation fair.
48	55	9	fair	shed	dry	damp, not well ventilated.
49	65	12	clean	barn	good	fair.
50	34	4	clean	milk house	dry	fair.
51	83	2	clean	milk house	excellent	good, fair.
52	12	4	dirty	milk house	wet	dirty, damp.
53	7	2	fair	sold at once	good	damp, no ventilation.
54	15	2	fair	milk house	damp	fair, poor ventilation.
55	13	5	fair	milk house	good.	fair, poor ventilation.
56	7	0	good	milk house	clean	dirty, no ventilation.
57	15	2	fair	milk house	bad	fair, poor ventilation.
58	14	4	fair	milk house	dry	good, fair ventilation.
59	7	2	fair	milk house	fair	poor ventilation.
60	24	1	fair	milk house	wet	poor, poor ventilation.
61	14	10	fair	outside tank	dry	damp, poor ventilation.
62	24	3	fair	milk house (bad)	fair	poor, ventilation poor.
63	4	0	fair	sells at once	good	fair, fair ventilation.
64	14	2	good	milk house	fair	damp, no ventilation.
65	4	1	fair	sold at once	good	no drain, damp.
66	19	13	fair	milk house	wet, dirty	dirty, damp, poor ventilation.

INSPECTION OF DAIRIES.—Continued.

ST. PAUL.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
67	20	0	fair	milk house	poor	dark, damp, dirty.
68	74	11	good	milk house	dirty	good, fair ventilation.
69	13	3	fair	milk house	dirty	damp, dirty.
70	2	2	fair	milk house	good	good.
71	7	7	fair	milk house	good	damp, not well ventilated.
72	24	0	fair	milk house	good	dark, not well ventilated.
73	25	7	good	milk house	good	poor ventilation.
74	15	2	fair	milk house	dry	damp, poor ventilation.
75	13	2	poor	milk house	good	damp, poor ventilation.
76	14	8	fair	milk house	no drain	damp, poor ventilation.
77	13	4	fair	milk house	fair	damp, not well ventilated.
78	35	1	fair	milk house	fair	damp, not well ventilated.
79	15	39	fair	milk house	fair	damp, dirty, poor ventilation.
80	10	0	fair	milk house (dirty)	good	damp, dark, dirty.
81	35	7	good	milk house	good	dry, well ventilated.
82	5	2	fair	outside	good	dry, not well ventilated.
83	10	4	fair	milk house	fair	dark, damp, fair ventilation.
84	12	19	fair	milk house	good	dark, dirty, damp.
85	16	1	fair	milk house	good	damp, poor ventilation.
86	24	0	good	milk house	good	dark, damp, dirty.
87	19	0	fair	outside	dirty	dark, damp, poor ventilation.
88	7	5	fair	milk house	poor	dark, damp, poor ventilation.
89	20	6	good	milk house	good	damp, poor ventilation.
90	6	9	fair	milk house		dirty, dark, poor ventilation.
91	1	16	good	milk sold at once	good	damp, poor ventilation.
92	10	12	good	milk house	good	dry, fair ventilation.
93	31	1	good	milk house	good	poor ventilation.
94	31	1	fair	milk house	good	damp, dirty, vent. not used.
95	13	0	fair	milk house	good	dark.
96	23	16	good	milk house	fair	dark, dry, poor ventilation.
97	19	0	fair	milk house	dirty	damp, poor ventilation.
98	12	2	poor	milk house	good	dark, dry, poor ventilation.
99	22	1	fair	tank in shed (dirty)	fair	dark, damp, poor ventilation.
100	.0	4	fair	uses the milk	good	dark, dirty, no ventilation.
101	6	1	fair	dwelling	good	dry, poor ventilation.
102	11	5	good	sells at once	dry	damp, poor ventilation.
103	5	0	good	milk house	good	no ventilation.
104	19	1	good	milk house	fair	dry, fair ventilation.
105	5	1	good	sells at once	good	no ventilation.
106	6	5	fair	tank	good	damp, poor ventilation.
107	6	0	fair	cellar	good	dry, poor ventilation.
108	11	0	poor	dwelling house	good	dirty, damp.
109	13	5	poor	shed (dirty)	good	damp.
110	15	8	fair	kitchen (dirty)	fair	dirty, fair ventilation.
111	13	2	fair	cellar	dirty	damp, dirty.
112	5	1	fair	dwelling house	dry	damp, poor ventilation.
113	8	1	fair	cellar	dirty	damp, dirty.
114	29	1	fair	shed	good	damp, poor ventilation.
115	15	9	fair	milk house	fair	damp, poor ventilation.
116	43	0	excellent	milk house	good	dry, fair ventilation.
117	7	9	fair	shed	fair	damp, poor ventilation.
118	7	0	fair	milk sold at once	bad	unsanitary.
119	9	2	fair	cellar	fair	damp, dirty, poor ventilation.
120	21	2	fair		bad	dark, damp, dirty.
121	9	18	fair	milk house	dirty	dirty.
122	3	8	good	tank	good	fair ventilation.
123	13	4	fair	tank	dirty	poor ventilation.
124	9	8	good	milk house	dirty	damp, poor ventilation.
125	10	4	fair	cellar	good	fair ventilation.
126	12	0	fair	milk house	dry	dark, damp, poor ventilation.
127	23	10	fair	milk house	dry	damp, poor ventilation.
128	16	0	fair	milk house (dirty)	bad	unsanitary.
129	29	4	fair (dirty)	shed	bad	damp, dirty, fair ventilation.
130	17	2	fair	cellar	fair	dry, fair ventilation.
131	7	4		tank	bad	damp, no ventilation.
132	9	2	fair	milk house	fair	damp, poor ventilation

INSPECTION OF DAIRIES.—Continued.

ST. PAUL.

Record No.	Herd.		Condition of Cattle.	Milk Kept In.	Condition of Stable.	
	No. Tested.	No. Not Tested.			Outside.	Inside.
133	1	5	fair (dirty)	sells at once	good	dark, damp, poor ventilation.
134	5	0	fair	sells at once	good	dry, poor ventilation.
135	11	8	fair	milk house	dirty	damp, no ventilation, dirty.
136	4	0	fair	tank	wet	dark, dirty, no ventilation.
137	3	1	fair	sells at once	wet	dark, no ventilation.
138	60	22	fair	milk house	dirty	dark, damp, poor ventilation.
139	7	2	fair	milk house	bad	unsanitary.
140	7	6	fair	milk house	fair	poor ventilation.
141	3	7	fair	shed	fair	unsanitary.
142	3	6	fair	shed	fair	unsanitary.
143	9	23	fair	shed	wet	dark, damp, poor ventilation.
144	3	1	fair	milk house	good	dry and fair ventilation.
145	19	0	fair	shed (dirty)	dirty	dirty, poor ventilation.
146	0	0				
147	41	17	fair	milk house	wet	dark, damp, poor ventilation.
148	29	1	good	milk house	good	good.
149	13	0	fair	milk house	good	dry, poor ventilation.
150	20	2	fair	milk house (dirty)	wet	fair.
151	7	0	fair	milk house	dry	dry, no ventilation.
152	20	4	fair	sells at once	dry	dark, poor ventilation.
153	10	1	good	tank	good	damp, poor ventilation.
154	22	3	poor	milk house	fair	dark, damp, fair ventilation.

ROSE TOWNSHIP.

155	29	5	good	milk house	fair	dark, damp, poor ventilation.
156	31	5	good	milk house	fair	damp, poor ventilation.
157	1	42	good	milk house	good	dark, damp, poor ventilation.
158	6	41	fair	milk house	good	damp, poor ventilation.
156	0	0	fair	milk house	good	dirty, damp, poor ventilation.
160	3	22	good	milk house	good	good light, dry, well ventilated.
161	26	15	fair	milk house (dirty)	good	damp, poor ventilation.
162	2	17	good	milk house	good	dry, poor ventilation.
163	8	18	fair	milk house	good	damp, well ventilated.
164	13	10	fair	milk house	good	dry, not well ventilated.
165	8	43	good	milk house	good	damp, no ventilation.
166	33	9	fair (dirty)	milk house	good	dry, poor ventilation.
167	18	20	fair	milk house	good	dark, dry, well ventilated.
168	28	7	good	milk house	good	dark, dry, fair ventilation.
169	8	3	fair	milk house	good	damp, poor ventilation.
170	4	42	good	milk house	good	damp, poor ventilation.
171	8	52	poor (dirty)	milk house	dirty	damp, poor ventilation.
172	30	1	fair	milk house	fair	damp, poor ventilation.

MOUNDS VIEW TOWNSHIP.

173	23	23	good	milk house	good	excellent.
174	27	43	excellent	milk house	good	dry, fair ventilation.
175	11	28	good	milk house	good	dry, fair ventilation.
176	24	9		milk house	fair	dry, fair ventilation.
177	58	7		milk house	wet	dark, not well ventilated.
178	3	20	fair	milk house	wet	poor ventilation.
179	12	21	good	shed	fair	dry, fair light and ventilation.
180	24	9	fair	milk house	good	dark, fair ventilation.
181	18	14	good	milk house	good	fair.

INSPECTION OF DAIRIES.—Continued.

NEW CANADA TOWNSHIP.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
182	12	7	fair	?	fair	dirty, damp, poor ventilation.
183	12	1	fair	milk house	good	poor ventilation.
184	13	0	fair	milk house	good	damp, no ventilation.
185	54	6		milk house	good	fair ventilation.
186	12	3	fair	milk house	dirty	poor ventilation.
187	22	0	fair	milk house	dirty	damp, poor ventilation.
188	0	5	fair		dry	poor ventilation.
189	11	6	fair	outside	fair	damp, poor ventilation.
190	14	10	fair	dwelling	dry	damp, fair ventilation.
191	10	2	fair	milk house	dirty	damp, poor ventilation.
192	12	0	fair (dirty)	milk house	wet	dark, damp, poor ventilation.
193	6	1	fair	dwelling	dry	dark, dry, poor ventilation.
194	2	3	fair	dwelling house	dry	dry, fair ventilation.
195	12	7	fair	milk house	wet	dry, fair ventilation.
196	24	13	fair	milk house	good	damp, dark, fair ventilation.
197	39	20		tank	wet	unsanitary.
198	5	3	fair	tank	dirty	dark, dirty.

LILLYDALE, DAKOTA COUNTY.

199	9	7	good	cellar	dry	damp, poor ventilation.
200	44	3	fair	barn	dry	dark, damp, poor ventilation.
201	0	19	good	milk house	wet	damp, fair ventilation.
202	7	0	fair	milk house	good	damp, fair ventilation.
203	10	9	fair (dirty)	shed	dirty	damp, dirty, poor ventilation.
204	16	0	fair	outside	good	damp, poor ventilation.
205	6	0	fair	milk house	dry	dark, poor ventilation.
206	5	6	good	milk house	wet	poor ventilation.

MENDOTA, DAKOTA COUNTY.

207	17	3	fair (dirty)	barn	good	damp, poor ventilation.
208	10	2	fair (dirty)	outside	wet	damp, poor ventilation.
209	16	5	good	shed	fair	damp, poor ventilation.
210	14	0	fair	tank	good	damp, poor ventilation.
211	10	3	poor	milk house	good	damp, poor ventilation.
212	9	3	fair	outside	good	damp, poor ventilation.

WOODBURY, WASHINGTON COUNTY.

213	6	3	?	tank	wet	dark, dry, poor ventilation.
214	8	3	good	tank	good	dry, poor ventilation.
215	23	1	good	tank	wet	damp, dirty, poor ventilation.

SOUTH ST. PAUL, DAKOTA COUNTY.

216	28	10	fair	milk house	wet	damp, fair ventilation.
217	12	25	good	milk house	good	dry, fair ventilation.
218	7	8	fair	milk house	good	dirty, poor ventilation.

INSPECTION OF DAIRIES.—Continued.

WASHINGTON COUNTY.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
219	14	3	fair	tank	good	dry, poor ventilation.
220	11	10	good	milk house	good	dry, poor ventilation.
221	6	8	fair	tank	good	damp, poor ventilation.
222	21	3	good	milk house	dry	poor ventilation.
223	35	0	fair	tank	dirty	damp, poor ventilation.

MINNEAPOLIS.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
224	10	9	good	barn	wet	damp,fair light and ventila'n.
225	0	10	good	milk house	dry	damp, no ventilation.
226	55	7	fair	milk house	wet	damp, dirty, fair ventilation.
227	16	0	fair	milk house	fair	light, dry, poor ventilation.
228	1	2	good	sells at once	good	fair light and ventilation.
229	10	10	fair	milk house	wet	damp, no ventilation.
230	7	17	good	milk house		dry, fair ventilation.
231	4	25	fair	shed	wet	dark, damp, poor ventilation.
232	11	3	dirty		dirty	dirty, poor ventilation.
233	6	11	poor	milk house	wet	unsanitary.
234	1	7	fair	milk house	good	damp, dirty, poor ventilation.
235	2	3	fair	sells at once	wet	dark, poor ventilation.
236	51	11	good	milk house	dirty	dark, damp, poor ventilation.
237	4	6	poor		good	dark, dirty, poor ventilation.
238	6	11	dirty	milk house	dry	dry, poor ventilation.
239	15	2	good	milk house	good	light, dry, fair ventilation.
240	18	6	good	milk house	good	dry, poor ventilation.
241	35	18	fair	shed	dry	dark, damp, poor ventilation.
242	4	5	good	milk house	good	dark, dry, poor ventilation.
243	0	3	fair	dwelling house	good	damp, poor ventilation.
244	17	8	fair	milk house	dry	dark, dry, fair ventilation.
245	22	15	good	milk house	good	dry, poor ventilation.
246	11	11	fair	milk house	good	damp, no ventilation.
247	0	17	good	milk house	good	dark, damp, poor ventilation.
248	13	0	good	milk house	good	light, dry, well ventilated.
249	27	5	good	milk house	good	light, dry, well ventilated.
250	14	0	fair	milk house	good	light, dry, fair ventilation.
251	22	0	good	milk house	clean	light, dry, well ventilated.
252	16	4	good	milk house	clean	light, dry, well ventilated.
253	20	11	good	milk house	good	light, dry, fair ventilation.
254	8	1	good	milk house	fair	light, dry, well ventilated,
255	28	9	good	barn	good	light, dry, fair ventilation.
256	7	2	good	milk house	fair	dark, dry, poor ventilation.
257	11	16	good	milk house	good	light, dry, poor ventilation.
258	7	6	fair	milk house	wet	light, dry, poor ventilation.
259	29	1	good	milk house	fair	dark, damp, fair ventilation.
260	29	1	good	milk house	good	light, dry, fair ventilation.
261	30	12	fair	milk house	fair	light, dry, fair ventilation.
262	3	0	fair	milk house	good	light, dry, poor ventilation.
263	3	13	good	milk house	fair	dark, damp, poor ventilation.
264	35	0	good	milk house	damp	dark, damp, poor ventilation.
265	2	7	good	sells at once	fair	unsanitary.
266	0	14	good	milk house	good	dry, dark, poor ventilation.
267	16	12	good	milk house	bad	dry, poor ventilation.
268	15	13	good	shed	good	dark, dry, fair ventilation.
269	9	15	fair	outside	fair	dark, damp, poor ventilation.
270	4	5	fair	milk house	fair	dark, damp, fair ventilation.
271	5	13	fair	milk house	good	dark, dry. poor ventilation.
272	7	8	fair	milk house	good	damp, poor ventilation.
273	25	4	good	milk house	good	dark, dry, poor ventilation.
274	23	17	excellent	milk house	good	dark, damp, poor ventilation.
275	12	10	good	milk house	good	light, dry, well ventilated.
276	15	12	good	milk house	poor	dry, poor ventilation.
277	20	6	good	milk house	good	dark, dry, poor ventilation.
278	0	18	good	milk house	good	light, dry, poor ventilation.

INSPECTION OF DAIRIES.—Continued.

MINNEAPOLIS.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
279	17	0	fair	milk house	good	light, dry, well ventilated.
280	20	5	good	milk house	good	light, dry, well ventilated.
281	10	3	good	milk house	good	light, dry, well ventilated.
282	5	3	good	milk house	good	light, dry, well ventilated.
283	11	2	good	milk house	good	light, dry, well ventilated.
284	31	1	good	milk house	fair	light, damp, well ventilated.
285	35	3	good	milk house	fair	light, dry, well ventilated.
286	19	10	good	milk house	good	light, dry, poor ventilation.
287	23	0	good	milk house	good	light, dry, half ventilated.
288	21	2	fair	milk house	good	dark, dry, fair ventilation.
289	20	5	fair	milk house	good	light, dry, fair ventilation.
290	0	15	good	milk house	clean	dry, not well ventilated.
291	0	6	fair	milk house	clean	light, dry, well ventilated.
292	12	2	fair	milk house	good	dark, dry, poor ventilation.
293	40	23	good	milk house	good	dark, damp, poor ventilation.
294	16	3	fair	shed near barn	fair	damp, light, poor ventilation.
295	8	3	good	milk house	good	dark, dry, well ventilated.
296	11	0	fair	away from barn	clean	dark, dry, fair ventilation.
297	20	0	good	away from barn	good	light, dry, well ventilated.
298	19	0	good	milk house	good	dark, dry, well ventilated.
299	30	0	good	in barn	good	light, dry, well ventilated.
300	10	3	good	milk house	good	dark, dry, well ventilated.
301	42	0	fair	milk house	wet	light, dry, well ventilated.
302	40	0	fair	milk house	good	light, dry, fair ventilation.
303	4	3	good	milk house	good	light, dry, good ventilation.
304	36	0	good	milk house	good	light, dry, poor ventilation.
305	44	0	fair	milk house	fair	dark, dry, well ventilated.
306	23	0	good	milk house	good	light, dry, well ventilated.
307	25	0	fair	milk house	good	light, dry, not well ventilated.
308	20	0	good	milk house	good	light, dry, well ventilated.
309	12	0		sells at once	good	light, dry, well ventilated.
310	23	0	good	milk house	fair	damp, fair light and ventila'n.
311	0	5		milk house	good	light, dry, fair ventilation.
312	14	8		milk house	fair	light, damp, fair ventilation.
313	7	3	fair	milk house	fair	dark, dry, fair ventilation.
314	25	0	good	milk house	good	light, dry, well ventilated.
315	10	8	fair	milk house	good	dark, dry, poor ventilation.
316	22	1	good	milk house	good	light, dry, fair ventilation.
317	10	0		milk house	good	dark, dry, poor ventilation.
318	18	2	good	milk house	good	light, dry, fair ventilation.
319	15	25	good	milk house	good	light, dry, well ventilated.
320	17	1		milk house	good	light, dry, fair ventilation.
321	14	4	good	milk house	good	light, dry, well ventilated.
322	2	2		milk house	good	light, dry, well ventilated.
323	85	15	good	milk house	good	dark, dry, fair ventilation.
324	5	15	fair	upstairs in barn	good	light, damp, poor ventilation.
325	8	6	good	cellar		light, damp, poor ventilation.
326	5	23	poor	milk house	dirty	dark, dirty, poor ventilation.
327	5	12	fair	upstairs in barn	bad	fair light, poor ventilation.
328	10	14	fair	dwelling	good	dark, dry, fair ventilation.
329	7	2	fair	dwelling	good	dirty, damp, no ventilation.
330	10	6	fair	cellar	good	light, damp, poor ventilation.
331	1	6		dwelling	good	dark, damp, poor ventilation.
332	8	12	fair	dwelling	good	light, damp, no ventilation.
333	0	14	fair	dwelling	dry	dark, damp, poor ventilation.
334	7	2	good	shed	dirty	poor light, damp, poor vent.
335	9	11	good	dwelling	good	light, damp, poor ventilation.
336	13	0		in barn	good	light, dry, fair ventilation.
337	6	5		in barn	good	light, dry, well ventilated.
338	1	4	fair	sells at once	fair	light, damp, no ventilation.
339	8	0	fair	sells at once	good	dark, damp, fair ventilation.
340	7	0	fair	sells at once	wet	light, dry, well ventilated.
341	2	9	fair	milk house	clean	light, poor ventilation.
342	0	2	fair	sells at once	dirty	light, damp, fair ventilation.
343	1	1	dirty		dry	poor light, dirty.

INSPECTION OF DAIRIES.—Continued.

MINNEAPOLIS.

Record No.	Herd.		Condition of Cattle.	Milk Kept In.	Condition of Stable.	
	No. Tested.	No. Not Tested.			Outside.	Inside.
344	15	1	fair	cellar	dry	light, damp, no ventilation.
345	11	2	fair	dwelling	good	light, damp, poor ventilation.
346	11	10	fair	dirty shed	dry	dark, dirty, poor ventilation.
347	16	14	fair	milk house	dirty	light, damp.
348	0	6	good	sells at once	clean	light, fair ventilation.
349	20	3	fair	sells at once	dirty	dirty, dark, damp, no vent'n.
350	15	1	poor	seils at once	wet.	dark, damp, poor ventilat'n.

ST. ANTHONY TOWNSHIP, HENNEPIN COUNTY.

351	29	10	good	milk house	wet	light, dry, poor ventilation.
352	2	5	fair	dwelling	good	clean, light, damp, poor vent.
353	22	6	excellent	milk house	clean	light, damp, poor ventilation.
354	14	11	fair	milk house	fair	light, dry, poor ventilation.

ST. LOUIS PARK.

355	10	10	good	milk house	dirty	light, damp, fair ventilation.
356	90	46	good	milk house	good	light, dry, well ventilated.
357	27	0		barn	good	light, dry, fair ventilation.
358	32	8	good	barn	good	light, damp, fair ventilation.
359	40	5	fair	milk house	wet	light, dry, well ventilated.
360	4	37	fair	milk house	good	
361	14	4	good	milk house	fair	dark, dry, fair ventilation.
362	15	11		milk house	good	light, dry, well ventilated.
363	24	15	good	room near barn		light, dry, fair ventilation.
364	18	9	good	milk house	good	dry, light, well ventilated.
365	15	3	fair	milk house		light, dry, fair ventilation.
366	13	13		milk house	good	light, dry, well ventilated.
367	18	3	fair	milk house	good	light, dry, well ventilated.
368	10	9		milk house	fair	light, dry, well ventilated.
369	12	20	good	milk house	good	light, dry, fair ventilation.
370	7	13	good	milk house	good	light, dry, fair ventilation.
371	38	19		milk house	good	light, dry, well ventilated.
372	21	0	good	milk house	good	light, dry, well ventilated.
373	21	4	good	milk house	good	dark, dry, fair ventilation.
374	11	10	good	milk house	good	dark, dry, fair ventilation.
375	59	6	good	milk house	good	light, dry, fair ventilation.
376	64	6	good	milk house	good	light, dry, poor ventilation.
377	6	10	good	milk house	good	light, dry, well ventilated.
378	16	26	excellent	milk house	good	light, well ventilated.
379	10	26	good	milk house	good	
380	8	10	good	milk house	good	light, dry, ventilated.
381	30	10	good	in barn	good	light, dry, well ventilated.
382	20	10	good	in barn	good	light, dry, fair ventilation.
383	14	4	fair	in barn	fair	light, dry, fair ventilation.
384	17	7		in barn	good	light, dry, well ventilated.
335	15	6	fair	cellar	fair	light, damp, fair ventilation.
386	0	22		in barn	good	light, dry, fair ventilation.
387	69	7		in barn	fair	light, dry.

INSPECTION OF DAIRIES.—Continued.

RICHFIELD TOWNSHIP.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
388	30	6	fair	milk house	no drain	light, dry, fair ventilation.
389	28	0	good	milk house	good	light, dry, well ventilated.
390	8	5	good	milk house	clean	....
391	45	0	good	milk house	excellent	light, dry, well ventilated.
392	35	8	good	milk house	good	light, dry, well ventilated.
393	16	0	....	milk house	good	light, dry, well ventilated.
394	22	0	fair	milk house	good	light, dry, fair ventilation.
395	17	3	good	milk house	good	light, dry, well ventilated.
396	0	4	good	....	....	....
397	12	1	good	milk house	good	light, dry, well ventilated.
398	10	2	good	milk house	good	light, dry, well ventilated.
399	24	6	good	milk house	fair	dark, dry, poor ventilation.
400	20	5	excellent	milk house	good	light, dry, fair ventilation.
401	20	10	good	milk house	good	dark, dry, fair ventilation.
402	13	4	good	milk house	good	light, dry, fair ventilation.
403	35	0	good	milk house	good	light, dry, well ventilated.
404	25	7	good	milk house	good	light, dry, fair ventilation.
405	22	8	good	milk house	good	light, dry, fair ventilation.
406	55	10	good	milk house	good	light, dry, well ventilated.
407	0	10	fair	milk house	fair	dark, dry, fair ventilation.
408	31	3	fair	milk house	good	light, dry, well ventilated.
409	25	0	good	milk house	good	dark, dry, well ventilated.
410	15	0	good	milk house	good	light, dry, well ventilated.
411	10	14	fair	milk house	fair	dark, dry, well ventilated.
412	35	35	fair	milk house	fair	light, damp, well ventilated.
413	0	16	good	milk house	good	dark, dry, fair ventilation.
414	1	28	fair	milk house	good	light, dry, well ventilated.
415	17	0	good	milk house	good	light, dry, well ventilated.
416	7	7	good	milk house	dirty	dark, damp, poor ventilation.
417	18	1	good	milk house	fair	dark, dry, fair ventilation.

HOPKINS.

418	4	16	excellent	milk house	good	light, dry, well ventilated.
419	0	0	good	....	good	light, dry, well ventilated.
420	1	35	good	milk house	good	light, dry, fair ventilation.
421	3	27	good	milk house	good	light, damp, well ventilated.
422	11	20	good	in barn	good	light, dry, well ventilated.
423	25	16	good	in barn	good	dark, dry, poor ventilation.

PLYMOUTH TOWNSHIP.

424	25	0	poor	milk house	good	dark, damp, fair ventilation.
425	24	0	good	milk house	good	light, dry, fair ventilation.
426	3	31	fair	milk house	dirty	light, damp, fair ventilation.

GOLDEN VALLEY.

427	31	0	....	milk house	good	light, dry, fair ventilation.
428	27	2	good	milk house	good	light, dry, fair ventilation.
429	28	4	good	milk house	good	light and dry.
430	3	42	good	milk house	good	light, dry, well ventilated.
431	20	20	good	milk house	good	light, fair ventilation.
432	33	6	....	milk house	good	light, dry.
433	22	3	....	milk house	good	light, dry, well ventilated.
434	25	0	good	tank	good	light, dry, well ventilated.
435	22	0	....	in tank	good	dark, dry, half ventilated.

INSPECTION OF DAIRIES.—Continued.

GOLDEN VALLEY.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
436	15	16	....	milk house	good	light, dry, well ventilated.
437	16	4	good	tank...............	good	light, dry, well ventilated.
438	23	17	good	milk house	good	light, dry, fair ventilation.
439	40	8	....	milk house	good	light, dry, well ventilated.
440	8	26	good	milk house	good	light, dry, well ventilated.
441	16	0	....	milk house	good	light, dry, fair ventilation.
442	20	0	....	milk house	good	light, dry, fair ventilation.
443	30	4	good	milk house	fair.........	light, dry, fair ventilation.
444	15	5	good	milk house	good	light, dry, fair ventilation.
445	22	0	good	in tank............	good	dark, dry, fair ventilation.
446	25	5	....	milk house	good	light, dry, fair ventilation.
447	14	4	good	milk house	fair.........	light, dry, fair ventilation.
448	7	1	good	milk house	good	dark, dry, fair ventilation.
449	18	7	....	milk house	good	light, dry, well ventilated.
450	40	8	....	milk house	good	light, dry, well ventilated.
451	5	9	....	milk house	good	light, dry, fair ventilation.
452	50	48	....	milk house	fair.........	light, dry, fair ventilation.
453	20	4	....	milk house	good	light, dry, well ventilated.
454	25	25	....	milk house	good	light, dry, well ventilated.
455	9	35	good	milk house	good	light, dry, well ventilated.
456	10	13	good	milk house	....	light, dry, well ventilated.
457	28	3	good	milk house	good	light, dry, fair ventilation.
458	76	1	good	milk house	good	light, dry, well ventilated.
459	25	7	fair...........	in barn............	good	dark, dry, fair ventilation.

MINNETONKA.

460	14	2	....	ice box outside....	good........	light, dry, well ventilated.
461	15	7	....	milk house	fair.........	light, dry, fair ventilation.
462	0	10	....	milk house	....	light, dry, fair ventilation.
463	0	7	....	milk house	good........	....
464	0	11	....	milk house	good........	light, dry, fair ventilation.
465	16	6	....	milk house	good........	light, dry, well ventilated.
466	21	4	....	milk house	fair.........	light, dry, well ventilated.
467	30	20	fair...........	milk house	good........	light, dry, well ventilated.
468	20	22	....	milk house	good........	light, dry, well ventilated.
469	15	15	good..........	milk house	good........	light, dry, fair ventilation.
470	40	0	good..........	milk house	good........	light, dry, well ventilated.

BROOKLYN.

471	50	21	good..........	milk house	fair.........	light, dry, fair ventilation.
472	29	4	good..........	milk house	good........	light, dry, good ventilation.
473	19	10	fair...........	milk house	good........	light, damp, poor ventilation.
474	26	0	good..........	milk house	fair.........	light, dry, fair ventilation.
475	42	1	good..........	milk house	fair.........	dark, damp, fair ventilation.
476	12	0	fair...........	ice tank............	....	dirty, no light, no ventilation.
477	17	2	poor..........	milk house	good........	light, dry, fair ventilation.
478	0	5	good..........	milk house	good........	dark, no ventilation, but dry.

INSPECTION OF DAIRIES.—Continued.

FRIDLEY.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
479	11	15	good	milk house	....	dark, damp, no ventilation.
480	21	0	excellent	spring house	excellent	light, dry, well ventilated.
481	0	0	poor	milk house	....	dark, no ventilation.
482	27	3	good	milk house	fair	light, damp, no ventilation.
483	1	29	good	milk house	good	dark, dry, fair ventilation.
484	18	3	fair	milk house	good	dark, dry, fair ventilation.
485	0	9	good	milk house	good	light, dry, fair ventilation.
486	8	9	fair	milk house (dirty)	....	dark, poor ventilation, damp.
487	20	1	fair	milk house	good	good light, dry, fair ventilat'n
488	40	2	good	milk house	good	light, dry, fair ventilation.
489	16	2	fair	milk house	good	light, dry, poor ventilation.
490	17	10	good	milk house	good	light, dry, ventilat'n stopped.
491	8	6	good	milk house	wet	dark, dry, fair ventilation.
492	23	1	fair	milk house	good	dark, dry, fair ventilation.
493	19	21	fair	in tank	dirty	dark, damp, poor ventilation.
494	16	12	good	milk house	good	dark, dry, fair ventilation.
495	111	42	good	milk house	good	light, dry, fair ventilation.
496	10	6	fair	shed	fair	dark, damp, fair ventilation.
497	0	13	fair	milk house	no drain	dark, damp, poor ventilation.
498	0	12	fair	....	fair	dark, not well ventilated.
499	4	21	....	....	good	dark, damp, fair ventilation.
500	0	19	poor	tank outside	dirty	dark, damp, poor ventilation.

CRYSTAL LAKE TOWNSHIP.

Record No.	No. Tested.	No. Not Tested.	Condition of Cattle.	Milk Kept In.	Outside.	Inside.
501	14	2	good	milk house	good	dark, dry, no ventilation.
502	0	12	fair	milk house	good	light, dry, well ventilated.
503	3	15	fair	milk house	fair	dirty, damp.
504	18	3	good	milk house	....	dark, dry, poor ventilation.
505	32	2	good	milk house	good	dark, dry, fair ventilation.
506	32	21	fair	milk house	fair	dark, damp, fair ventilation.
507	35	9	good	milk house	fair	light, damp, fair ventilation.
508	26	1	good	milk house	good	light, dry, fair ventilation.
509	15	2	good	milk house	good	dark, dry, poor ventilation.
510	14	11	fair	milk house	good	dark, damp, fair ventilation.
511	19	16	good	milk house	good	light, dry, good ventilation.
512	16	2	fair	milk house	fair	dry, light, well ventilated.
513	8	16	good	milk house	good	dark, dry, fair ventilation.
514	30	15	good	in barn	good	dark, damp, fair ventilation.
515	20	23	fair	barn (water dirty)	fair	dark, dirty, poor ventilation.
516	20	4	fair	barn	fair	light, dry, poor ventilation.

EDINA.

Record No.	No. Tested.	No. Not Tested.	Condition of Cattle.	Milk Kept In.	Outside.	Inside.
517	14	0	good	tank outside	good	light, damp, close, no vent.
518	9	2	good	tank outside	good	dark, damp, fair ventilation.
519	25	1	fair	shed.	good	light, damp, fair ventilation.
520	7	0	fair	milk house	good	good light, damp, fair vent.
521	0	20	good	out of doors.	good	light, dry, fair ventilation.
522	6	24	good	milk house	dirty	light, dry, poor ventilation.
523	15	0	good	milk house	clean	light, dry, fair ventilation.
524	9	2	....	milk house	clean	light, dry, well ventilated.
525	24	10	fair, (clean)	milk house	good	light, dry, well ventilated.
526	48	3	good	milk house	fair	light, dry, well ventilated.
527	19	9	good	....	good	light, dry, well ventilated.
528	6	1	fair	milk house	good	light, dry, well ventilated.
529	40	7	good	milk house	good	light, dry, well ventilated.
530	14	6	good	milk house	good	light, dry, well ventilated.
531	4	2	good	milk house	good	light, dry, well ventilated.

INSPECTION OF DAIRIES.—Continued.

EDINA.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
532	10	0	good	milk house	good	light, dry, fair ventilation.
533	28	12	good	in barn.	good	light, dry, fair ventilation.
534	20	0	good	milk house	good	light, dry, well ventilated.
535	11	0	good	milk house	good	light, dry, poor ventilation.
536	9	0	good	milk house	dirty	dry, well ventilated.
537	0	29	fair	close to barn	good	light, dry, well ventilated.
538	10	0	good	milk house	good	light, damp, fair ventilation.
539	30	0	fair	in barn	good	light, damp, fair ventilation.
540	8	0	fair	dwelling	excellent	light, damp, fair ventilation.
541	21	12	fair	shed near barn.	fair	light, damp, fair ventilation.
542	24	3	good	tank	good	excellent.

BLOOMINGTON TOWNSHIP.

Record No.	Herd. No. Tested.	Herd. No. Not Tested.	Condition of Cattle.	Milk Kept In.	Condition of Stable. Outside.	Condition of Stable. Inside.
543	16	0	fair	milk house	good	dark, damp, fair ventilation.
544	4	14	fair	milk house	wet	dark, damp, fair ventilation.
545	16	0	good	milk house	good	light, damp, fair ventilation.
546	20	5	good	milk house	good	dark, damp, fair ventilation.
547	0	13	fair	milk house	good	light, damp, fair ventilation.
548	8	4	fair	tank outside	good	dark, dry, fair ventilation.
549	7	0	fair	milk house	good	light, damp, fair ventilation.
550	2	12	fair	milk house	good	light, damp, dirty, fair vent.
551	15	9	good	milk house	good	dark, fair ventilation, damp.
552	8	2	good	milk house	good	light, damp, fair ventilation.
553	14	15	good	milk house	good	light, damp, fair ventilation.
554	0	12	fair	milk house	good	light, dry, fair ventilation.
555	4	14	good	milk house	very good	light, dry, well ventilated.
556	0	8	good	milk house	very good	light, dry, fair ventilation.
557	0	8	good	milk house	good	light, dry, well ventilated.
558	9	1	good	milk house	good	light, dry, well ventilated.
559	8	7	good	milk house	good	light, dry, well ventilated.
560	0	11		milk house		light, dry, well ventilated.
561	3	12	fair	milk house	good	light, dry, well ventilated.
562	2	4	good	milk house	good	light, dry, well ventilated.
563	1	2	good	milk house	good	light, dry, fair ventilation.
564	2	12	fair	milk house	fair	light, dry, fair ventilation.
565	0	4	good	milk house	good	light, dry, well ventilated.
566	0	5	good	milk house	good	light, dry, well ventilated.
567	8	8	good	milk house	good	light, dry, well ventilated.
568	5	0	fair	milk house	good	light, dry, fair ventilation.
569	4	4	fair	milk house	dry	dark, dry, well ventilated.
570	6	0	fair	milk house	good	light, dry, well ventilated.
571	7	13	good	milk house	good	dark, dry, fair ventilation.
572	0	9	good	milk house	fair	light, dry, fair ventilation,
573	0	12	good	milk house	good	light, dry, fair ventilation.
574	0	5	good	milk house	good	
575	0	9	good	milk house	good	light, dry, fair ventilation.
576	0	10	good	milk house	fair	light, dry, fair ventilation.
577	20	9	good	milk house	good	light, dry, well ventilated.
578	28	7	very good	barn	good	light, dry, poor ventilation.
579	10	8	fair	milk house	fair	dark, dry, poor ventilation.
580	24	0	clean	barn	fair	dark, dry, poor ventilation.
581	22	0	good	milk house	good	light, dry, fair ventilation.
582	10	15	good	milk house	good	dark, dry, fair ventilation.
583	0	7		dwelling		light, damp, fair vent., dirty.
584	0	3	fair	dwelling	good	dark, damp, fair ventilation.
585	52	8	fair	tank near barn	dirty	dark, damp, fair ventilation.
586	5	13		in barn	fair	light, dry, well ventilated.

The form of blank used in the inspection of dairies reported in part in the preceding table reads as follows:

Date....................

No ....Herd of..

Located at (City, Village or Township)..

Breed of cattle..

Bulls: No. tuberculin tested.................. Breed......................

No. not tuberculin tested............... Breed......................

Cows: No. tuberculin tested........................

No. not tuberculin tested...........................

Calves: No. heifers..............................

No. bulls................................

No. of cows on hand when herd first tested.................................

No. of cows still on hand from first test..

No. of tuberculin tests of herd.................Dates........................

If cattle tested, number each time: 1st............2nd..........3rd........

No. reacted on first test...................... Date..........................

No. reacted on second test.................. Date...........................

No. killed ....Dates..................................

No. passed as fit for food.......................No. condemned.............

No. tested cattle purchased since first testing of herd........................

Dates ....

No. non-tested cattle purchased since first testing of herd....................

Dates ....

Total number of cows owned since the first testing of herd.................

No. of tested cows on hand........No. of non-tested cows on hand...........

Condition of cattle (Poor, fair, good, excellent)...........................

Character of feed used...

Date of beginning business...

How much milk sold daily..

Where is milk kept..

Surroundings of stable..

Style of stable (photograph)..

Interior condition of stable (Dark, light, damp, dry, well ventilated).......

Style of fastenings for cattle...

Style of stall..

No. of cubic feet per animal (estimated)..

Who tested cattle each time...

....

By order of...

(Local board of health, owner, or state board of health.)

Remarks ....

....

....Name and address of Reporter

In the quarterly report for the veterinary department ending June 30, 1902, is the following:

"The people of the Twin Cities are getting all that they are paying for, and few milk consumers are sufficiently interested in knowing the character of their milk supply to make inquiry or to visit the dairy supplying them. Dairymen who are keeping their dairies in the best condition are getting little if any more for their milk than are those who are keeping the poorest dairies.

A summary of the conditions given in the table shows that there are but seven (7) dairies that can be classed as excellent. One hundred and sixty-four (164) as good. One hundred and eighty-six (186) as fair. With two hundred and twenty-nine (229) classed as unsatisfactory. Milk was kept in:

Dirty milk houses	9
Sheds	30
Outside tanks	42
Cistern	1
Barn	28
Dwelling house or cellar	36

Considering the unsanitary conditions of many of the stables it is unfortunate that the conditions should be made still more objectionable through the place where the milk is kept. Cows kept under unsanitary conditions might possibly produce milk which would not be the direct cause of sickness, provided the milk was properly handled and kept free from contamination. It is, however, almost, if not quite, impossible to keep milk in a dirty milk house, barn, shed, cistern or dwelling house without its contamination.

Early in 1902 there was much discontent from country districts near Minneapolis, relative to the Minneapolis testing. Many of the town boards said they were willing to have the dairy cattle within their jurisdiction tested, but were not willing that this should be done by the Minneapolis authorities. The Minneapolis veterinarian announced in the Spring of 1902, that he would recognize no test in that city, but their own. Other townships said they were willing to have their dairy cows within their jurisdiction tested *provided* some means was taken to prevent the purchase of non-tested cows to take the place of the condemned cows.

On June 22, 1902, a conference was held at the office of the State Board of Health at which Drs. Keyes of Minneapolis, Kirby and Pomeroy of St. Paul and Brimhall (veterinarians) also Dr. P. M. Hall, commissioner of health, Minneapolis, and Dr. Bracken were present. Dr. Ohage was unable to attend.

The following propositions for the State Board of Health were submitted: "While we endorse the tuberculin test as a means of recognizing the presence of bovine tuberculosis, we do not consider the present methods employed in St. Paul and Minneapolis, viz.: the testing of cattle; the condemning of those which react to the tuberculin test; the removal of such condemned animals from the herd; the purchase of other animals to take the place of those condemned, such animals not having been submitted to the tuberculin test; the continued use for dairy purposes of such untested animals for an indefinite period;—as tending to secure a non-tuberculous milk supply. We therefore suggest the acceptance of one of the following propositions:

(1) That the compulsory testing of dairy herds be continued only on condition that some means be provided by which dairymen can replenish their herds with tuberculin tested cattle;

That no dairyman be permitted to sell milk, in either city, from a herd containing any untested cows;

That attention be given to the disinfection of dairy barns from which condemned animals have been removed;

That proper attention be given to the ventilation and general sanitation of dairy barns and the places in which milk is stored;

That sufficient inspection be made of these places to secure a permanent improvement of dairy barns and milk supplies.

(The table preceding seems to indicate the need of such propositions as the above.)

(2) That if the above plan is not feasible, the testing of dairy herds with tuberculin be discontinued until such time as it can be adopted, recognizing as a reason for the discontinuance of such testing the fact that the present method is unsatisfactory and is not yielding the results claimed for it.

(3) That if the cities are not ready to accept either of the foregoing propositions the State Board of Health be permitted to withdraw from such unsatisfactory work, leaving the cities to deal directly with adjoining local boards of health (town boards of supervisors).

Dr. Ohage not being present no action could be taken for St. Paul, but Dr. Hall and Dr. Keyes both expressed themselves as not ready to accept the first or second proposition for Minneapolis, but quite willing to follow the third. The conference adjourned with this understanding.

Following this came the Mounds View township case where the Minneapolis authorities tried to compel the State Board of Health to

enforce the slaughter of animals which had been condemned by the city veterinarians outside of their jurisdiction. The State Board of Health was governed in its action by the advice of Attorney General Douglas, which was to the effect that the Minneapolis sanitary authorities might exclude any dairyman's milk from their city, but had no right outside of the city limits to condemn cattle for which the township and state had to pay. This opinion was sustained by Judge Brooks.

The following statement shows the amount of money paid out by the state as its one-third of cattle killed after inspection for tuberculosis. Also the amount paid appraisers.

A statement of Expenditures from the Infectious Diseases of Animals' Fund for Reimbursements for Cattle Killed for Tuberculosis and for Appraisers' Fees:

	Appraised Tuberculous Cattle.	Service of Appraisers.
May, 1901	$162.52	....
June, 1901	622.36	$103.00
July, 1901	675.01	62.00
Totals	$1,459.89	$165.00

August, 1901	255.63	80.00
September, 1901	254.76	41.00
October, 1901	664.45	25.00
November, 1901	208.26	19.00
December, 1901	200.15	15.00
January, 1902	359.82	11.00
February, 1902	60.53	4.00
March, 1902	341.57	18.00
April, 1902	310.10	8.00
May, 1902	333.09	19.00
June, 1902	614.95	12.00
July, 1902	194.85	10.00
Totals	$3,798.16	$262.00

August, 1902	625.89	6.00
September, 1902	264.55	20.00
October, 1902	734.41	154.00
November, 1902	226.04	12.00
December, 1902	92.27	....
January, 1903	520.89	10.00
February, 1903	366.89	13.00
March, 1903	251.21	12.00
April, 1903	256.65	8.00
Totals	$3,338.80	$235.00
Grand total	$8,596.85	$662.00

In connection with the testing of cattle it was necessary to establish certain regulations and records. Some of these are found in the eighteenth biennial report of the Minnesota State Board of Health. Pages 316-319.

The following circular of information relating to bovine tuberculosis was issued under date of Aug. 1, 1901, for the use of local health officers:

The law now provides that whenever an animal has been adjudged infected with the disease of tuberculosis and has been ordered killed by the state or local board of health, such animal shall be appraised at a valuation not to exceed $40. The value of the hide and carcass is to be deducted from the amount of appraisal, and the balance is to be paid for, one-third by the state, one-third by the local board, and the remaining one-third shall be borne by the owner.

All cases of suspected tuberculosis must be promptly reported to the State Board of Health on blanks provided for that purpose.

The State Board of Health shall be duly notified before any cattle are ordered killed on account of tuberculosis.

All cattle for dairy or breeding purposes brought into this state must be accompanied by a health certificate from a veterinarian, whose competency and reliability are certified to by the authority charged with the control of the diseases of domestic animals in the state from which the cattle are shipped. Said health certificate must show that the cattle have been examined and tested with tuberculin, and are free from any contagious disease.

It shall also contain the owner's statement that the cattle have not been exposed to anthrax, blackleg, actinomycosis, malignant catarrh, or Texas fever during the preceding three months. Compensation is not allowed for cattle slaughtered on account of tuberculosis, which have not been owned in the state at least one year prior to the date of slaughter.

Milk from creameries should be boiled before use for feeding purposes.

Local health officers of towns, villages and cities of Minnesota are hereby

authorized and instructed to seize and hold in quarantine all cattle for dairy or breeding purposes coming into this state without a legal permit or proper health certificate, and to notify the State Board of Health at once of such action. The law provides that whenever any animal is quarantined in transit the expense of quarantine shall be borne by its owner or keeper.

Note.—Your attention is especially called to the rules and regulations of the Minnesota State Board of Health, for the prevention of the importation of diseased animals into Minnesota. These rules and regulations require that Range horses, cattle for dairy or breeding purposes, and hogs or sheep for breeding purposes shipped into Minnesota must be accompanied by a health certificate satisfactory to this board.

S. D. BRIMHALL, V. M. D.,
Director Veterinary Department.

In carrying out the law of 1901, which provided compensation to owners for cattle slaughtered because of tuberculosis, it was necessary to have a record of appraisal, etc. The following record sheet was prepared and put into use.

APPRAISAL OF ANIMAL.

We have this day examined a (Insert description of animal)..........
Tag No.......quarantined for tuberculosis in the (city or town)...........
of .... and hereby appraise its value at $.......
The animal has been in the state...
Dated ...., 190....

..........................residing at ....
.... " " ....
.... " " ....

Appraisers.

DESCRIPTION AND REPORT OF ANIMAL SLAUGHTERED.

Description of animal.............................Tag No..............
Date of first test.....Date of state quarantine.....Date of second test.....
Owner's name and address..
Killed at (Slaughter house or private premises)........................
Lesions: Lungs ....Pleura ....Liver ....

Postpharyngeal ....
Bronchial ....

Lymphatics:

Mediastinal ....
Mesenteric ....
Mammary ....

Disposed of as follows..

Weight ....

Carcass:

Amount received ....
Weight ....

Hide:

Amount received ....

Remarks ....
....

..................Inspector.

When cattle were appraised and killed it was necessary for the sanitary authority doing the killing to furnish a certified copy of appraisal and description of the animal to the second sanitary authority held legally responsible for its third of the appraised value of the animal (city, village, or township superintending the killing to furnish certified copy to the state or vice versa)—hence the following on the reverse side of the appraisal blank given above.

STATE OF MINNESOTA,
ss:
County of.............

I hereby certify that I have carefully compared the foregoing appraisal of animal and report of its slaughter with the original written appraisal of said animal, and the original written report of its slaughter, on file and of record in the office of the .... Board of Health, and that they are true and correct copies of said original appraisal and of the said original report of slaughter.

Witness my hand this ....day of..............., 190...

....

Secretary of the .... Board of Health.

The testing of dairy cattle with tuberculin has been encouraged throughout the state. Dairymen and stockmen have been urged to recognize the importance of protecting their herds from tuberculosis. For this missionary work the following form was prepared and used.

REQUEST FOR INSPECTION AND TUBERCULIN TEST OF HERD, AT THE EXPENSE OF THE MINNESOTA STATE BOARD OF HEALTH.

.................................1903.

To the Minnesota State Board of Health, St. Paul,

Gentlemen: I have reason to believe that some of my cattle are afflicted with tuberculosis, and I wish to have my entire herd inspected and tested with tuberculin, if such test is deemed necessary by your representative, and the diseased animals disposed of according to the rules and regulations of the State Board of Health.

I understand that the first inspection and test will be made at the expense of the state, and in consideration thereof I agree to employ the means recommended by your board to prevent the re-introduction and development of tuberculosis in my herd. To this end I agree to kill all animals which give positive reaction to the test, to thoroughly disinfect the stable,

and to purchase only cattle which have been proven free from tuberculosis as shown by examination and test made by a veterinarian recognized by your board.

Very truly,

....

Address..................................

Township.................. County..................

My herd includes the following animals: Cows ...., heifers over one year old......................., bulls over one year old ...., steers...................... The milk from this herd is used by................................ for...................... The cattle are (State breed and whether registered)...................... The following are my reasons for believing that some of my herd are afflicted with tuberculosis: ....

Requests, as provided for in the above form, have come from breeders of common rather than of pure bred cattle. The latter in many instances hesitating to subject their animals to such a test; fearing financial injury. Whenever a majority of the breeders of common cattle have become interested in maintaining healthy herds their influence will be felt among the breeders of pure bloods.

There are already a few pure pure bred herds maintained under the tuberculin test, and the number of buyers of pure bred cattle who demand the protection of the tuberculin test as a condition of purchase, is on the increase.

Cattle have been tested in the following counties: Anoka, Dakota, Faribault, Hennepin, Le Sueur, Mower, Polk, Ramsey, Redwood, Sibley, Steele, Waseca, Washington and Wright.

Cattle were tested in Anoka, Dakota, Hennepin, Ramsey and Washington counties because of compulsion through St. Paul and Minneapolis. The other tests were demanded by local boards of health in districts supplied from the dairies, or were voluntary. The history of some of the tested herds is interesting. In one instance a herd of high grade cattle was tested by a local veterinarian with many reactions following. Inquiry brought out information from the owner that he had known of the presence of tuberculosis in his herd for two years (of course during this period he had been selling infected animals, and thus spreading the disease, to probably non-infected herds). The loss from death was becoming so heavy in his herd that he decided to take advantage of the law, which provided compensation for tuberculous animals slaughtered, thus protecting himself against the total loss of his herd.

The testing of a herd in one case was brought about in such a peculiar way that it is worthy of record. A medical health officer

noticed some meat hanging in a butcher's shop, which had a suspicious appearance. He sent a portion of this meat to the State Board of Health laboratory from which in due time he received a report that the meat was tuberculous. The health officer thereupon inquired of the butcher where he obtained the tuberculous animal, and was referred to a certain herd, the owner of which was not only willing but anxious to have his cattle tested. The result of the test showed twenty-six infected animals out of a herd of thirty-four.

In another instance cattle in a herd began dying. The owner, in conversation with Dr. Annand described their condition. Dr. A. suggested that the cattle probably had tuberculosis. At the request of the owner he made a post-mortem on a cow that had died a few days previously. The lesions of tuberculosis were present to quite a marked degree. A test of the herd was thereupon advised and made by Dr. A. with the result that eight out of a herd of twenty-six reacted, and were slaughtered.

In another instance Dr. Annand when on a trip of inspection was asked by a farmer to see a pure bred cow that he had recently purchased at a sale of pure breds in Iowa. Dr. A. informed him that the cow had tuberculosis, and advised the testing of the herd. The farmer followed this advice. Of forty-one animals tested, three reacted, two of which came from the sale above referred to. The third animal had been on the place for a considerable period. She had been closely associated, however, with the newly purchased cows for a little over two months (post-mortem of this case showed but a few primary lesions). The farmer thereupon began legal action against the breeder who sold the two infected cows, but the case was settled out of court.

Dr. A. found two other pure bred cows sold at this same sale to another farmer in the same Minnesota county that were diseased. This man also began action against the breeder who sold him the cows.

In another instance a farmer noticed that one of his cows was ill. He wrote to the state board for advice. It was suggested to him that in all probability she had tuberculosis. He thereupon requested a test of his herd. This was made with the result that this cow only, in a herd of five, had tuberculosis. He had bought her of a neighbor. The other four had been raised on his own place.

In another instance when a farmer noted that some of his cows were not healthy, a test was made with the result that eight out of thirteen reacted and were slaughtered.

In still another case in the country where a request was made for a test thirty-eight out of fifty-three animals reacted and were slaughtered.

In another instance a local veterinarian tested the herd of a farmer upon the owner's request and found every animal diseased. In this case the farmer traced the source of infection to a cow purchased at a sale, which died of tuberculosis. These few illustrations point out the importance of stockmen and farmers protecting their herds from tuberculosis by the wise use of the tuberculin test. The following table gives some idea of the cattle tested from Oct. 1, 1901, to April 23, 1903. It should be noted that the use of the test outside of the twin cities was steadily on the increase.

TUBERCULIN TEST RECORD NO. 1.

Period.	Cattle: Tested.	Cattle: Killed.	Cattle: In quarantine.
Oct. 1, 1901	.....	....	59
Oct. 1 to Dec. 31, 1901	3,060	123	....
Oct. 31, 1901	....	....	85
Dec. 31, 1901, to March 31, 1902	3,024	90	....
March 31, 1902	.....	....	144
March 31 to June 30, 1902	2,578	147	....
June 30, 1902	.....	....	187
June 30 to Sept. 30, 1902—			
St. Paul	15		
Minneapolis, July, August	*868	175	....
State at large	220		
Sept. 30 to Dec. 31, 1902—			
St. Paul	918		
Minneapolis, October	*954	93	....
State at large	418		
Dec. 31, 1902, to April 23, 1903	*1,250	....	....

*Records for quarter incomplete.

The records of the tuberculin test for 1901 and 1902 are shown in the following table:

TUBERCULIN TEST RECORD NO. 2.

	1901.	1902.
Number of cattle tested	9,982	9,292
Number reacted	458	719
Number killed	315	471
Number retested	216	178
Number reacted on retest	157	83
Total number killed during the year	469	483

The records of testing and killing during a period of over four years is given below:

TUBERCULIN TEST RECORD NO. 3.

	1899.	1900.	1901.	1902.	1903 to April 21.
Number tested....	5,725	7,405	9,982	9,292	1,250*
Number killed.....	62	185	469	483	193*

*Minneapolis records incomplete.

Laboratory Investigations. In addition to the above described routine work of the board in handling tuberculosis in cattle in this state, the following special investigations have been made:

(1) *Hugo, Washington County*—May 29, 1901, there was received in the laboratory a package containing a large suppurating gland from a cow. The specimen had been sent by Mrs. A. G. W. of Hugo, Minn. The animal had been sick for several weeks before being killed and was greatly emaciated. Examination of the carcass by the hired man revealed only this large supperating gland near the trachea.

Direct coverslip preparations of sections of the tissue were stained for tubercle bacilli, but none were found. The tissue itself was non-tuberculous.

(2) *Kellogg, Wabasha County*—Aug. 5, 1901, there was received in the laboratory a nodule about .5 c.c. in diameter from Dr. Annand. The gland had been removed August 3d, at 10 a. m., from the colon wall of a two months' old pig, killed for the purpose of autopsy when very sick of supposed tuberculosis. The pig was the property of Mr. A., near Kellogg, Minn., and was one of several exhibiting symptoms of tuberculosis after having been fed for some weeks on the milk of cows (shorthorns) which were probably tuberculous. The specimen was placed in 10 per cent formalin at 2 p. m., Aug. 5, 1901, and hardening completed in 96 per cent alcohol. Specimen imbedded in parrafin, cut, stained with hæmatoxylon and eosin, carbol fuchsin and methylene blue and examined Aug. 13, 1901. Specimens stained with hæmatoxylon and eosin showed a cheesy, amorphous mass in the center, surrounded by small round cells, which in turn were enclosed in fibrous walls. At one side the villi of the intestines were seen. The intestinal wall at this point was infiltrated throughout with small round cells. Decomposition changes had evidently occurred between the removal of the specimen and its fixation.

Specimens stained with carbol-fuchsin and methylene blue gave a few solitary and one group of three tubercle bacilli. Those seen were mostly within the vicinity of the intestinal wall, near the villi. The specimen was apparently a large, much degenerated tuberculous nodule of the intestinal wall.

(3) *Waseca, Waseca County*—On Nov. 22, 1901, there was received from the Secretary of the State Board of Health two oval pieces of tissue about 1¼ inches in diameter and of a yellowish red appearance. These were said to be glands removed from a supposedly tuberculosis cow belonging to Mr. A. E., Waseca, Minn., and forwarded by Dr. J. F. Lynn, of Waseca. They consisted of a firm fibrous capsule containing a soft, cheesy material in which were small pieces of lime. The cut surface had the same yellowish red color as the capsule.

Microscopic Examination: Stained preparations made directly from the material showed no evidence of *B. tuberculosis*, and cell structure could not be made out. Bacteria of various appearances were present. Cultures made from the centers of the masses showed many large bacilli of varying lengths, probably putrefactive and also *B. pyocyaneus*.

Animal Inoculations: Guinea pig No. 466, weight 525 grammes, was inoculated intraperitoneally with .5 c. c. of broth emulsion of the center of gland. It began to lose weight shortly after inoculation and died January 7th, i. e., 46 days after inoculation. At the site of inoculation in the abdominal wall was an ulcer with indurated edges and a curdy, cheesy material at its base. In this cheesy material tubercle bacilli were demonstrated microscopically. The tissues of the guinea pig showed minute tubercles throughout.

Guinea pig No. 467, weight 545 grammes, was inoculated subcutaneously in the right groin at the same time and in like manner as guinea pig No. 466. This animal steadily lost weight, developed a tuberculous ulcer at the site of inoculation, showed swelling and induration of the glands of the groin and was found dead on January 13th, i. e., 52 days after inoculation. Autopsy showed generalized tuberculosis.

This shows conclusively the presence of *B. tuberculosis* in the material from which the guinea pigs were inoculated. That they were probably few in number was indicated by the failure to demonstrate them microscopically in the smears made directly from the tissue and by the fact that the guinea pigs succumbed to tuberculosis only after a prolonged delay.

(4) *Grafton, N. D.*—Saturday, Dec. 7, 1901, there was received in the laboratory from Mr. F. of Grafton, N. D., a portion of lung and liver from an animal. These were wrapped in a newspaper and placed in a cigar box. Accompanying the specimen was the following letter:

I send you some pieces of tissue for examination. They were taken from a cow that died a few days ago. The cow seemed in good order and gave birth to her first calf when all at once she began to get poorer and poorer until she finally died. This is the third one that has died in the same way this spring. I also have another that seems to be affected in the same manner. They seem to have a good appetite but do not seem to pick up any when they start to get poor. When one feels of the hide and presses against the flesh it seems as though the flesh about was lifeless. I have also a yearling that looks as though she was gradually beginning to fail. The small piece I send was cut off from the lung. All the parts had the disagreeeable odor that this has. One would think that the animal had been dead a long time by the smell of the lungs just after she died.

Yours truly,

G. W. F.

The tissues consisted of a portion of the liver and portion of lung. The liver contained a large cheesy mass of granular material of a yellowish color. The lung was studded with small calcareous masses. Both pieces of tissue were badly decomposed and unfit for use. Direct coverslip preparations were stained for tubercle bacilli. No tubercle bacilli were found. A culture taken from the lung showed a white staphyloccus. There was no growth obtained from the liver.

(5) *State Experiment Station, Ramsey County*—May 23, 1902, Drs. Brimhall, Reynolds and Lyford made an autopsy at the State Experiment Station on a Tamworth boar, aged about four years, which died after a few days' illness. Post-mortem examination showed a marked pneumonia with tubercles of the pleura and pericardium; also an apparently tuberculous growth on the vertebræ in the region of the first dorsals. This growth extended into the interior of the vertebral column and pressed upon the spinal cord. Portions of the growth and portions of the tissues and bronchial lympathatics were brought to the laboratory.

Direct coverslip preparations of sections of the tissue stained with carbol-fuchsin and methylene blue showed no tubercle bacilli. The tissue was non-tuberculous in histological appearances.

Guinea pig No. 538, weight 280 grammes, was inoculated May 23, 1902, intraperitoneally with 4 c. c. of the emulsion from the medias-

tinal gland noted above. The animal was found dead on the morning of June 25th, from mixed infection. It was thus impossible to determine by the laboratory examination the presence or absence of tubercle bacilli.

(6) *Triumph, Martin County*—Aug. 8, 1902, Dr. E. L. Blackmun of Triumph, Minn.. sent to the laboratory a specimen of a cow's lung, and accompanied by the following letter:

> I have sent by express today parts of the lung of a cow which has recently died. Tuberculosis supposed to be the cause of death. Being chairman of the board of health there people have come to me objecting to the farmer (who owns the herd in which the cow died) selling beef, butter or milk from the herd.
>
> E. L. BLACKMUN.

The specimen, when received in the laboratory, was found to be poorly preserved in Mueller's fluid. It was, therefore, unsuitable for other than histological examination and was too poorly preserved to admit of a satisfactory examination even of the histology. The matter of examination of the herd was referred to the director of the Veterinary Department, who communicated with Dr. Blackmun concerning the matter, but received no reply.

(7) *Waseca, Waseca County*—March 28, 1903, Dr. J. F. Lynn, H. O., of Waseca, Minn., sent to the laboratory a specimen of supposedly tuberculous individuals taken from the thoracic cavity of a cow. The specimen was accompanied by the following letter:

> I am sending you by mail today some diseased tissue in the form of granules taken from the thoracic cavity of a cow killed for the purpose of being sold as beef. These nodules were closely adhering to the inner surfaces of the ribs and surrounding organs of the chest cavity. There were hundreds of them varying in size from a pea to a pigeon's egg. In all appearances the case is somewhat as the one reported by me Nov. 22, 1901, and examined by you at that time and pronounced tuberculosis. I have therefore condemned this meat, but for the satisfaction of the owner will be very glad if you will give me as early report as possible of your examination.
>
> J. F. LYNN, H. O.

An examination of the specimens showed them to consist of a mass of tuberculous tissue, and a report of the diagnosis was forwarded to Dr. Lynn.

Summary.—The very general employment of the tuberculin reaction renders laboratory work usually unnecessary in the rou-

tine diagnosis and control of tuberculosis in cattle. This does not mean that there is not a great deal of pathological and bacteriological work still to be done in connection with this very widespread disease, which is so important from a public health and commercial standpoint.

America has been the foremost of all the nations in recent investigations bearing upon the possible transmission of this disease from animals to man, and the work of Ravenal, Pearson and de Schweinitz would seem to indicate, beyond all doubt, that typical tuberculosis may be produced in cattle, monkeys and various other animals, as well by the tubercle bacillus from human sources as by those of bovine origin. This work is so well covered by these other observers that there seemed little necessity for paralleling it in Minnesota, particularly as so many problems which seemed to be of more local significance were continually being unearthed.

The few desultory examinations have not been without interest, however, and tuberculosis has been shown present by the laboratory in both cattle and swine. The investigation of the material forwarded from the meat carcass exposed for sale, mentioned above, and the subsequent attention to the heard from which the animal came, based upon the laboratory report, is a sufficient argument for the desirability of a laboratory which can be consulted in the work of investigation and control of infectious diseases of animals, more particularly those to which man is also susceptible.

The demonstration by the laboratory of tuberculosis in swine which had been fed, presumably, tuberculous milk, raises the question as to the necessity for laboratory investigation of skim milk from creameries, so largely used for feeding calves and swine. There seems to be good reason for believing that the recent serious increase in tuberculosis in swine in this and adjoining states, as met with by government inspectors, is due largely to this method of feeding. Certainly so serious a menace to the swine raising industry demands a careful investigation by both clinical and laboratory methods, especially since the question involved has an important bearing upon human food products (pork, milk, butter, etc.).

GLANDERS.

When the duties of a director fell upon Dr. S. D. Brimhall, August, 1900, there were then in quarantine in the state eighty-one (81) horses that had been tested with and reacted to mallein,

but which showed no clinical symptoms of the disease. Some of these horses had been tested first early in 1898. The rules then in forc required the testing of all animals that had been exposed force required the testing of all animals that had been exposed to glanders. (See page 306, eighteenth report Minnesota State Board of Health.)

These rules were not considered practical, and were changed at the board meeting Jan. 15, 1901, to read as follows:

1. In all ordinary cases of suspected glanders-farcy, first quarantine the suspected animals, then call a competent veterinarian, who shall make such examination and tests as he may deem necessary. The further action of the board shall be largely determined by diagnosis and advice of the veterinarian.

2. All horses, mules or donkeys that are discharging from the nose, or that have had recent sores upon the body, and all animals that have worked as mates with such infected animal must be included in this preliminary quarantine.

3. After Feb. 1, 1901, all horses, mules or donkeys which show positive symptoms of glanders, with or without mallein reaction, must be destroyed without delay.

4. After Feb. 1, 1901, all exposed animals which give one clear reaction to the mallein test, or which show any of the recognized external symptoms of glanders, must be destroyed.

5. All exposed horses, mules or donkeys not showing clinical symptoms of glanders must be placed in quarantine for a period of six months without the mallein test. General use of such animals may be permitted, but they must not be sold, traded or given away during the quarantine period. The quarantined animal or animals must not be fed or watered at any public feeding or watering place.

Provided however, that if at any time the owner presents to the State Board of Health a certificate of a veterinarian showing that an animal so quarantined has been subjected to the mallein test by a veterinarian, approved by the State Board of Health, and that such veterinarian has failed to detect the presence of such disease, then said board may remove the quarantine; and provided further, that in case upon such test such veterinarian certifies that such animal is affected by such disease, then such animal shall be killed forthwith by the Local Board of Health.

Quarantined horses, mules or donkeys shall be inspected by a competent veterinarian, under the supervision of the State Board of Health, once in three months.

Quarantine must not be released in any case until the owner has disinfected the premises as directed by health officers.

In all cases where retests are made, the second dose must be one-half larger than the first.

Carcasses must be destroyed by burning, if practical, otherwise buried under four feet of earth.

The first set of rules required the testing of all horses that had been exposed to glanders. The ones just quoted did not call for the testing of all exposed animals, but did require that those which showed no clinical evidences of the disease should be placed under quarantine for a period of six months, if not tested. Even this quarantine period, if thought advisable, might be extended. The use of animals under quarantine was permitted with certain precautions.

Under the first rules, animals reacting to the mallein test, were placed under quarantine without exhibiting any clinical symptoms of the disease. (Some of these animals are still under quarantine, although to all appearances perfectly healthy.)

The following list shows the number of horses killed on account of glanders in each county by years:

1901.

Wadena 3, Marshall 3, Carlton 2, Hubbard 14, Cass 4, Swift 3, Becker 6, Clay 6, Red Lake 10, Roseau 3, Hennepin 85, Renville 7, Polk 25, Morrison 1, Lac qui Parle 2, Wilkin 1, Rice 3, Ramsey 40, Aitkin 2, St. Louis 24, Lincoln 11, Watonwan 1, Washington 6, McLeod 2, Blue Earth 5, Rock 2, Cottonwood 1, Anoka 27, Freeborn 1, Redwood 5, Pine 3, Big Stone 1, Traverse 5, Dakota 1.

1902.

Blue Earth 1, Becker 6, Benton 3, Carver 1, Cass 2, Clay 2, Chippewa 2, Chisago 1, Dakota 2, Douglas 3, Hennepin,* 6, Hubbard 1, Jackson 3, Kittson 19, Otter Tail 7, Marshall 4, Mower 4, Murray 1, Nicollet 2, Nobles 1, Polk 20, Ramsey 39, Red Lake 1, Redwood 8, Renville 2, Rice 1, St. Louis 8, Steele 9, Swift 6, Todd 1, Traverse 1, Wilkin 2, Washington 5, Wadena 3.

1903.

Washington 9, Kittson 3, Marshall 4, Ramsey 18, St. Louis 1, Becker 1, Hennepin,* 1, Carlton 5, Lyon 2, Itasca 6, Dakota 1, Beltrami 1, Le Sueur 1, Murray 1.

The following table shows the number of horses tested and killed from Jan. 1, 1897, to April 21, 1903:

	1897.	1893.	1899.	1900.	1901.	1902.*	1903* to April 21st.
Number tested...	391	381	490	474	500	191	83
Number killed....	180	165	168	122	315	177	54

*Note.—Records for Hennepin county incomplete.

Formerly there was no compensation rendered to owners of glandered horses, and this fact was at times the cause of great distress to the poor. This was especially true in the country districts where at times it has happened that a farmer had all of his horses slaughtered on account of glanders in the midst of his busy season, at the same time leaving him without means to buy others. These hardships will no longer be possible since the passage of the Krostue bill. (See page 17.)

Three cases of glanders among human beings have recently occurred in this state. These will be fully reported upon in the nineteenth and twentieth reports of the State Board of Health. Stated briefly they were as follows: Early in 1901 a health officer in the northern part of the state telephoned to the secretary of the State Board of Health that he had a young man with a very peculiar eruption, suggesting even the possibility of smallpox. This latter disease was excluded. In a few days the young man died. Soon after a brother of this patient was taken ill with similar symptoms. He, too, died. Material was taken from this second patient and sent to the State Board of Health laboratory for examination with the result that the disease was shown to have been glanders. The laboratory worker who had charge of this investigation accidentally became inoculated and has now been ill with glanders for a year with a fair prospect of complete recovery.

Examination demonstrated the fact that the first patient received his infection from his own horses that were suffering from glanders. The second patient may have had his infection either from his brother's horses or from his brother, for he took care of him during his illness.

The State Board of Health, realizing the danger from the importation of animals, passed the following regulations October, 1901:

The importation into the State of Minnesota of range horses, cattle for dairy or breeding purposes, hogs or sheep for breeding purposes, is hereby prohibited, except in compliance with the following rules and regulations:

1. Range horses, cattle for dairy or breeding purposes and hogs or sheep for breeding purposes must be accompanied by a health certificate. Said health certificate shall not be accepted by the state or local boards of health, except when signed by the owner of the animals described in the certificate, and containing his statement to the effect that the described animals have not been exposed to any contagious or infectious disease during the three months prior to the date of certificate. The health certificate shall also contain satisfactory proof that the said animals have been properly inspected, and in case of cattle for dairy or breeding purposes it shall also contain

satisfactory evidence of their having been subjected to the tuberculin test, and that each and every animal is free from disease.

The inspections and tests must be made by a graduate veterinarian, whose reliability is vouched for by the authority charged with the control of infectious diseases of animals in the state or territory from which the animals come.

2. Local health officers of towns, villages and cities of Minnesota are hereby authorized and instructed to seize and hold in quarantine all live stock as designated in Sec. 1, coming into this state without a legal permit or satisfactory health certificate, and to notify this board, at once, of such action.

3. All animals found in the State of Minnesota, in violation of this order, must be held in quarantine until they can be properly examined by a veterinarian under the authority of the State Board of Health. The expense of quarantine and examination must be paid by the owner or agent of the quarantined animals, as prescribed by law.

It shall be the duty of all persons, corporations and companies to give due and full notice to the State Board of Health of Minnesota, preceding the arrival at the boundary line of Minnesota, of all live stock which come within the provisions of these rules and regulations.

Note.—Blank forms for making out health certificates will be furnished by this board on application.

Sec. 6805, General Statutes of Minnesota, 1894:

Whoever, being the owner, or having the charge of any animal, knowing the same to have any infectious or contagious disease, or to have been recently exposed thereto, sells or barters the same, or knowingly permits such animal to run at large, or knowing such animal to be diseased as aforesaid knowingly permits the same to come into contact with any other animal, or another person, without his knowledge and permission, shall be fined not more than one hundred nor less than twenty dollars, or imprisoned not more than thirty days.

It will be seen that these bear upon the importation of horses, especially from the western ranges. The following health certificate was therefore required of those shipping range horses into Minnesota:

HEALTH CERTIFICATE FOR RANGE HORSES.

Date...............

This is to certify that on the above date I examined (number)........... range horses, the property of Mr.................. shipped in car No......, and found them free from all evidence of contagious or infectious disease.

....
(Signature of Veterinarian.)

....
(Address.)

OWNER'S STATEMENT.

I do hereby certify that the above mentioned horses have been in my possession for ...., and they have not to my knowledge been exposed to any contagious or infectious disease during the past three months.

....
(Signature of Owner.)

....
(Address.)

Laboratory Investigations.—Laboratory work in this disease has not been extensive, because usually a diagnosis is not a difficult matter for a skilled veterinarian. As a rule investigations have been undertaken only at the instigation of the Veterinary Department of this board in cases where some peculiar manifestation of the disease was encountered or for a verification of the mallein reaction. The mallein test is very generally employed and its accuracy is such that, in connection with clinical observation and autopsy demonstration, laboratory investigation is rarely necessary for a diagnosis of glanders in animals.

The laboratory method (Strauss) usually employed where there is reason to suspect that bacillus mallei is present in fluids or tissues, is to make an emulsion of the suspected material in sterile broth and inoculate it into the peritoneum of male guinea pigs. In these animals the testicles swell up in three or four days, if the glanders bacillus be present in the material used for inoculation, and it may usually be obtained in pure culture from the pus which fills the tunica vaginalis. This permits of the ready isolation of the bacillus when it is mixed with other micro-organisms in such materials as nasal discharge, pus or other exudates. Even where the material to be examined is such that it is possible to obtain the bacillus in purity in cultures made directly from it, for the identification of the micro-organism intraperitoneal inoculation of the male guinea pig is necessary.

The comparison of the accuracy of the laboratory and mallein tests made by Frothingham* in collaboration with the laboratory of the Boston City Board of Health shows the possibility of a small percentage of error in both, neither of which is of particular moment if careful clinical and post-mortem observations be carried on. It seemed undesirable to attempt to formulate methods for routine laboratory examinations for the diagnosis of this disease in Minnesota, owing to the great danger to the health of men and animals involved in the transportation of suspected materials

*Journal of Medical Research, Vol. VI., p 331.

and because of the accuracy of the mallein reaction and the fear that a loss of confidence in that reaction might be suggested by laying stress upon laboratory examination. The glanders bacillus has proven so dangerous to laboratory workers that some hesitation is felt in permitting investigation upon the micro-organism by the heads of certain laboratories.

The laboratory work of this board, although somewhat limited, has proven interesting. The earlier investigations (see pp. 131, 144, 164, 169 and 449, Biennial Report, 1897-98, and p. 452, Report 1899-1900) consisted largely of the examination of tissues, exudates and pus from horses or mules in which there was some unusual manifestation of the disease or some obscure point to be made clear. In one case an investigation to determine the possibility of hens acting as carriers of infection was requested. No data or material was forthcoming, however, which seemed to show a sufficient reason for the investigation. Notwithstanding the extreme susceptibility of bacillus mallei to germicides and other deleterious influences, in one instance (see above for reference) a portion of glandered horse's lung preserved in glycerine was shown to contain living virulent bacilli by cultures and animal inoculation made in the laboratory after its receipt.

Since the beginning of 1901 in connection with the field work carried on by this board (see preceding tables) the necessity or desirability of laboratory investigation has rarely arisen. Plans had been made and some material collected for the investigation of the chronicity of glanders in this state and the testing for the presence of living glanders bacilli in old lesions, especially in the lungs, for the purpose of comparison with the tuberculous processes in cattle. It was not possible to push this work forward, owing to other investigations for which there was more pressing necessity.

Amongst the examinations made may be mentioned the demonstration of glanders bacilli in pus forwarded by mail to the laboratory. After the lapse of several days, from the vial containing the putrid pus which had been collected without any special precautions as to asepsis, virulent glanders bacilli were obtained. Clinical observation and the mallein test would have yielded just as accurate results and the safety of the mails need not have been jeopardized, but when the life of a valuable animal is at stake such possibilities are apt to be lost sight of.

One of the most interesting investigations made in the laboratory has been the study of some cases of this disease in man in

which the infection was transmitted from a horse to the first case, a young man. During the course of his illness, which proved rapidly fatal, he was nursed by his brother, who contracted the disease in an acute form and died, whilst from material from a pustule on the face of the second case a third case was accidentally inoculated and assumed the chronic form. By means of a diphtheria outfit, pus from a cutaneous abscess on the face of the second case was collected after death and forwarded to the laboratory for examination and diagnosis, the nature of the disease being at that time unknown. The micro-organism was isolated from the pus and as it conformed, morphologically and biologically, in all media with glanders bacillus, it was inoculated (broth cultures) into the peritonea of male guinea pigs, in which it produced death in less than 24 hours, i. e., before sufficient time had elapsed to permit of the typical involvement of the testes. The bacilli were recovered in pure culture from the testicles and demonstrated in direct coverslip preparations made from them.

The third case infected accidentally from this source developed a chronic form of the disease, characterized by the formation of abcesses in the muscles, which were treated surgically. From the pus and tissues obtained at operation the bacilli were recovered sparingly, but in pure culture. As evidenced by inoculation into the guinea pigs, the bacillus had become somewhat attenuated in the third case as compared with case No. 2, since it now produced the typical lesion of the testicle in the guinea pig and was not so rapidly fatal after intraperitoneal injection. Clinical and laboratory data has been most carefully collected and preserved and the investigation will be fully reported in the forthcoming biennial report of this board, which deals with human disease, and also in one of the medical journals in collaboration with the physicians and surgeons who were in charge of the cases.

It seemed worthy of mention in this report as showing very clearly the relation of this disease to both men and animals, since the channel of infection from the glandered horses to the young man in charge of them, from him to his brother and from him to the third case is so accurately demonstrated. The extreme virulence of the human form of the disease was shown in the first two cases by the character of the symptoms and acuteness of the illness as well as by the evidence furnished by guinea pig inoculations. The necessity for very careful supervision and control of this disease by boards of health is so apparent that comment is unnecessary.

HOG CHOLERA.

This disease is transmitted from animal to animal much as is typhoid fever transmitted from man to man. While the germs of this disease may to a limited extent be carried by dust, it cannot be classed as air borne in its character. The ordinary methods of transmission are by infected animals, healthy animals carrying the infection, and infected water. It may to a limited extent be borne also by birds flying from an infected pen or pasture. The number of diseased animals in Minnesota has been greatly reduced since 1897, when the work of inspection and quarantine was first vigorously begun by the Minnesota State Board of Health. One good citizen who wished to disparage the work of the board attributed the diminished amount of the disease to Providence rather than to sanitary methods, but careful observation would tend to show that Providence used sanitary methods as his agent of bringing about the change. In 1897, and two or three years following, the disease was very general throughout the southern part of the state, so much so that farmers were discouraged and were disposed to look upon sanitary methods as ineffective in the control of the disease. It was no uncommon thing to find nearly, if not all, the farms of the township infected with an extremely heavy mortality and great financial loss resulting. It was hard with such conditions prevailing to convince farmers that the disease was not air borne. After an issue of circulars setting forth the character of the disease, supplemented by a careful inspection of the first outbreaks in a township the general prevalence of the disease in a neighborhood disappeared and we have left rather its occasional appearance on, in many instances, a single farm in a neighborhood. It has been demonstrated time and time again that where the local officials have early recognized the disease or have called to their assistance the State Board of Health, the spread of the disease has been absolutely controlled. On the other hand it has been strongly demonstrated that the concealment of the disease by hog owners or neglect to quarantine on the part of local officials has been followed by general infection of many neighboring farms. The localization of the disease as shown by the following tables gives good evidence of what can be accomplished when it is placed under sanitary supervision.

Early in the work of the board in its attempt to regulate this disease many remedies consisting of practically inert drugs were in the market, lauded by certain individuals as cures for hog cholera. In spite of scientific demonstrations to the effect that there is no cure for this disease, except in its prevention, we still find a few men in the state who maintain that the disease is not infectious, and that it can be controlled simply by regulating the diet of the animals. Such false teaching is most unfortunate. True it is that improper feeding may place the alimentary canal of the hog in such a condition as to make the animal more susceptible to infection, but no amount of irregular or improper feeding can cause the specific disease hog cholera without the presence of the specific germ of the disease.

The work involved in the control of this disease has been largely in the hands of Dr. J. G. Annand, field veterinarian, whose report is as follows:

In looking over the field after the year's work, one of the notable features of the hog cholera outbreaks in the state in the year 1900 is that more than half in the southeastern corner of the state were in the following counties: Goodhue, Wabasha, Winona, Houston, Fillmore, Olmsted, Mower, Steele, Freeborn, Faribault. In Fillmore county we found that hog cholera came in from Iowa, and also that hog cholera had existed in Wisconsin prior to the outbreak in Winona county.

Another noticeable feature of the outbreaks is that the heaviest loss has been in counties bordering on other states.

In regard to Clay county, it should be stated that hog cholera had existed there for four years, the supervisors never having made any report. I found on visiting that locality that the disease had been present for some time in North Dakota, across the river. The outbreak in Minnesota this year was in the townships bordering on the Red River of the North. A great number of dead hogs were found in the river, and the health officers of the Minnesota side claim that the Dakota farmers threw hogs into the Red river; hence, the cause of the outbreak.

In Redwood county, in the town of Honner, according to the report of the chairman of the board of supervisors, hog cholera had existed in that town for four years, and that they had made no report, nor did they make any attempt to control the disease. This was the center of the outbreak for Redwood county.

In Lyon county the outbreak was a sequence of infection in '99 through the stock yards.

In regard to Stearns county, the origin of the outbreak was from hogs shipped in and fattened in stock yards, and the outbreak spread from this private stock yard. This was also the cause of outbreaks in Sherburne and Benton counties.

During the year 1901 the disease appeared in 21 counties, involving 37 townships, 1 vilage and 2 cities; and there were 92 outbreaks. Infection came by way of Mankato through hogs shipped from Missouri; hogs that developed the disease shortly after their arrival.

In the city of St. Paul the disease was found in slaughtered hogs.

In the village of Ellsworth, Nobles county, infected hogs were held in the stock yards.

Dr. Brimhall or myself visited all outbreaks with the exception of 17. Of these seventeen the disease appeared on one farm only in fourteen cases. In one township there were two outbreaks, in another township three outbreaks, and in another township five, which were not visited by a representative of the State Board of Health, as the health officers had the situation well in hand when it was reported to the board.

The outbreaks in Benton and Stearns counties appear to be carried over from 1900.

In Courtland and Traverse townships, Nicollet county, the outbreaks came from the hogs that were shipped into this district by way of Mankato from Missouri.

In Bloomfield township, Fillmore county, from which township it is claimed the disease spread in 1900, causing great loss, cholera again appeared in the private stock yards of Mr. Hughes. From information I obtained while in that vicinity it appears that he had cholera in his private stock yards three consecutive years.

In Wise Side and Lismore townships, Nobles county, hog cholera was allowed to spread before the supervisors took any active measures towards suppressing the disease. Diseased hogs were allowed to run at large, and dead hogs were not buried. We were about to prosecute a number of negligent farmers in these two townships, but decided not to, as their negligence was due largely to their misunderstanding of the law, rather than to indifference.

Compring the small loss in Minnesota from hog cholera in 1901 with the great loss sustained during previous years, the state is to be congratulated on the good work in dealing with this disease.

Had the neighboring states been as watchful the disease would have been even less. The fact that the spread of the disease can be prevented, if careful sanitary regulations are observed, has been fully demonstrated.

During 1902 the largest outbreak was in Hunter township, Jackson county, where eight farms were infected. In this township the chairman of supervisors paid no attention to the disease, allowed hogs to remain unburied, and did not report to the State Board of Health at the time of the outbreak. We were informed indirectly about four months after the outbreak first appeared.

In Freeborn township, Freeborn county, and Pleasant Prairie township, Martin county, there were seven farms infected with hog cholera during the summer season. The same conditions prevailed in these two townships as in Hunter township.

In Pleasant Prairie township the origin of the outbreak was on a farm whose owner allowed his hogs to run at large and go to different farms in the neighborhood, and the dead hogs were left unburied. On my visit there I found carcasses in different stages of decomposition, and also found that the dogs had been at the carcasses. This man was prosecuted. He admitted his guilt and paid his fine.

The one outbreak in La Crescent township, Houston county, was due to infection from Wisconsin.

In Rose township, Ramsey county, the infection was brought from the International Live Stock Exposition at Chicago.

In Burnsville township, Dakota county, and Carlson township, Freeborn county, the township supervisors were indifferent, and did not take any active steps to control the disease until after I made them a visit advising them as to their duties. They followed my advice, and there were no further outbreaks.

The outbreaks of hog cholera at Butternut Valley and Lincoln townships, Blue Earth county, were due to infection from Cherokee, Ia., brought in February.

With a few exceptions there was no spread of the disease in townships visited by Dr. Brimhall or myself.

There were only nine outbreaks reported to which either Dr. Brimhall or myself did not pay a visit. In eight of these only one farm was infected, and in the other case only two farms were infected, disease spreading no further.

It is encouraging to note that the township boards of health are becoming more prompt and energetic in their efforts to suppress the disease, and are beginning to realize that the spread of

the disease can be prevented where infected hogs are properly quarantined and cared for and when the dogs are confined to their own premises.

Cholera appeared in 32 townships and two villages in 17 counties. In all there were 95 farms and one stockyard involved this year.

From Jan. 1, to April 23, 1903, there were 16 farms in 14 townships scattered through eleven counties affected with this disease of which I visited but two. One was at Alexandria, Douglas county. The outbreak appeared on one farm. The first hogs that showed the disease were taken from the railroad stockyards at Alexandria to this farm. As a result of this carelessness, the owner lost in the neighborhood of 70 hogs.

The other outbreak that I visited was in Eden Prairie township, Hennepin county. I could not learn how the disease originated on this place. They had lost some seven or eight hogs.

At Lake Park township, Becker county, and Eglon township, Clay county, quite a number of hogs died from cholera. These cases were under the care of Dr. Youngberg of Lake Park. The origin of this outbreak was from hogs that were exhibited at the World's Fair in Chicago and were apparently not looked after as they should have been at the time.

Outbreaks in Freeborn township, Freeborn county, Amherst township, Fillmore county, Hunter township, Jackson county, and Summit Lake and Lismore townships, Nobles county, were the continuation of outbreaks that had existed in these localities during 1902.

Mr. Pomplun visited the outbreak in Mounds View township, Ramsey county, where the disease was strictly quarantined and there was no further spread.

The following table gives the record of hog cholera for 1900, 1901, 1902 and 1903 to April 21:

HOG CHOLERA REPORT FOR 1900.

COUNTY.	Township.	Reported outbreaks in Twp.	Attitude of Local Health Officers.	Date of First Report.	Date of Last Report.	Date of Dr. Annand's Visit.	Outbreak quarantined.	Result.	Remarks.
Anoka	Centerville.....	5	Active..................	Oct. 12	Oct. 17	Oct. 26............	Early.........	Effective.........	In that vicinity last year.
Benton......	Sauk Rapids...	2	Active..................	Sept. 17	Sept. 22	Oct. 10............	Early.........	Effective.........	Infection from Stearns Co.
Benton......	Glendorado....	1	Active..................	Nov. 10	Nov. 16	....	Early........	....	Owner moved from Sherburne Co.
Clay.........	Glyndon........	1	Active..................	Oct. 24	Oct. 30	Oct. 24............	Early.........	Effective.........	
Clay.........	Kragnes........	1	Indifferent..........	Oct. 24	Oct. 24	Oct. 24............	No report	from C. B. S...	C. B. S. of Oakport twp. reports hog cholera present in Clay Co. for 4 years. This is the first report to State B. of H.
Clay........	Moland.........	2	Active..................	Oct. 24	Oct. 24	Oct. 24............	No report	from C. B. S..	
Clay.........	Morken	2	Active..................	Oct. 24	Nov. 5	Oct. 24............	Early.........	Effective.........	
Clay.........	Oakport........	5	Active..................	Oct. 24	Oct. 31	Oct. 24............	Late	Effective.........	
Faribault ...	Brush Creek...	5	Active......	Aug. 15	Sept. 29	Aug. 15............	Early.........	Effective.........	Cholera present on two farms early in July, but not quarantined until July 25.
Faribault....	Blue Earth.....	3	Active after July 25	July 28	Oct. 18	July 25	Late	Effective.........	
Faribault....	Elmore	4	Active after July 25	July 28	Sept. 3	July 25	Late	Effective.........	
Faribault....	Seeley	6	Active..................	Jan. 9	Dec. 18	Aug. 15............	Early.........	Effective.........	First outbreak Jan. 9, died out; second outbreak Aug. 6.
Faribault....	Winnebago	....	....	Nov. 2	....	....	....	....	
Fillmore	Amherst	1	Active.	Oct. 17	Oct. 29	....	Early.........	Effective.........	
Fillmore	Arendahl	2	Active..................	Sept. 24	Oct. 15	....	Early.........	Effective.........	
Fillmore	Beaver	9	Active..................	Sept. 25	Nov. 16	Sept. 25...........	Early.........	Disease spread...	Did not order dogs tied. Cholera in early spring, but not reported to C. B. S. until spread over eastern part of township.
Fillmore	Bloomfield.....	62	Active after Aug. 22	Aug. 18	Nov. 12	Aug. 22, Sept. 12	Late	Not effective.....	
Fillmore	Chatfield.......	2	Active..................	Sept. 24	Dec. 10	....	Early.........	Effective.........	
Fillmore	Forestville.....	2	?	....	....	Aug. 22, Sept. 12	Early.........	Good—Sept. 12..	
Fillmore	Holt............	1	....	Nov. 1	Nov. 1	....	....	....	
Fillmore	Jordan	8	Active..................	Aug. 31	Dec. 12	Sept. 22...........	Early...	Effective.........	F'll'w'd fullinstr'ct'ns of S.B.H.
Fillmore	Norway	8	Active..................	Oct. 1	Oct. 22	....	Early.........	Effective.........	Cholera came from hogs taken from private stock yard in Rushford.
Fillmore	Pilot Mound ...	1	Active..................	Oct. 19	Oct. 19	....	Early.........	Effective.........	
Fillmore	Preble..........	1	Active..................	Oct. 31	Nov. 13	....	Early.........	....	
Fillmore	Rushford	7	Not very active......	Aug. 5	Sept. 26	Sept. 21...........	Late	?	
Fillmore	Spring Valley..	10	Indifferent...........	July 30	Sept. 26	Sept. 26..........	Early.........	Not satisfactory.	Did not follow S. B. H. instructions.
Fillmore	Sumner........	13	Active..................	Aug. 16	....	Sept. 3 and 27....	Early.........	Effective.........	
Freeborn....	Alden	2	Active..................	Sept. 25	Oct. 22	Oct. 30............	Early.........	Effective.........	
Freeborn....	Carlston........	5	Active..................	Nov. 12	Nov. 12	Oct. 30............	Early.........	Effective.........	
Freeborn....	Emmons (Vil.)	3	Active..................	Nov. 2	Nov. 8	Nov. 12...........	Early.........	Effective.........	
Freeborn...	Freeman.......	3	Active..................	Feb. 21	Nov. 1	Nov. 1............	Early.........	Effective.........	

HOG CHOLERA REPORT FOR 1900—Continued.

County.	Township.	Reported outbreaks in Twp.	Attitude of Local Health Officers.	Date of First Report.	Date of Last Report.	Date of Dr. Annand's Visit.	Outbreak Quarantined	Result.	Remarks.
Freeborn	Mansfield	2	Indifferent	Nov. 1	Nov. 14	Nov. 1	Late	...	
Freeborn	Nunda	6	Active	Nov. 1	Nov. 13	Nov. 1	Early	Fairly good	
Freeborn	Pickerel Lake	7	Active	Nov. 1	Nov. 21	Nov. 1	?	Effective	Board doing nothing and nearly all these infected at time of Dr. Annand's visit.
Goodhue	Belvidere	27	Indifferent	Oct. 16	Oct. 26	Oct. 16	Late	Not effective	
Goodhue	Goodhue	8	Indiff. until Oct. 16	Oct. 16	Dec. 19	Oct. 16	Late	Effective	
Goodhue	Hay Creek	24	Indiff. until Oct. 16	Oct. 16	Dec. 4	Oct. 16	Late	Effective	
Goodhue	Wacouta	...	...	Sept. 15	...	...	...		
Grant	Lien	7	Active	Nov. 16	Nov. 16	Nov. 15	Late	...	
Hennepin	Brooklyn	3	Active	Jan. 16	Feb. 28	...	Early	Effective	
Houston	Caledonia	4	Active	Dec. 5	Dec. 19	Dec. 19	...	...	
Houston	Houston	1	Active	Sept. 13	Sept. 13	...	Early	Effective	
Houston	Money Creek	9	Active	Sept. 10	Nov. 24	Sept. 22	Early	Somewhat ef'tive	
Houston	Mound Prairie	2	Active	Nov. 9	Nov. 14	...	Early	?	
Houston	Yucatan	2	Active	Oct. 22	Nov. 22	...	Early	?	
LeSueur	Sharon	5	Indifferent	Nov. 9	Nov. 21	Nov. 9	Late	?	
Lyon	Eidsvold	2	...	...	Dec. 18	...	No action	Died out Dec. 19	
Lyon	Fairview	3	Indifferent	Oct. 5	Oct. 5	Oct. 5	Late	Died out	Quarantined a few cases, then stopped. After Dr. Annand's visit, quarantined again.
Lyon	Lucas	18	Active	Sept. 11	Oct. 13	Oct. 5	Late	Effective	
Mower	Racine	?	Indifferent	Sept. 10	Sept. 10	...	?	?	
Mower	Windom	7	Active	Sept. 25	Nov. 27	...	Late	?	
Nicollet	Belgrade	3	Indifferent	Nov. 8	Nov. 17	Nov. 8	Not q'r'tined	Died out	
Olmsted	Dover	2	Active	Sept. 19	Sept. 20	Sept. 18	Early	Effective	
Olmsted	High Forest	1	?	Sept. 10	Sept. 10	...	Early	?	
Olmsted	Orion	?	?	Oct. 11	Oct. 11	...	?	?	
Olmsted	Quincy	29	Active	Aug. 18	Oct. 10	Aug. 30, Sept. 19	Late	Not effective	Did not follow instructions regarding dogs and doves.
Olmsted	Salem	1	Active	Jan. 4	Jan. 4	...	Early	Effective	
Olmsted	Viola	2	Active	Aug. 30	Sept. 29	Aug. 30	Early	Effective	
Ottertail	Pelican Rapids	...	Indifferent	Dec. 3	Dec. 14	...	...	...	
Ramsey	Rose	1	Active	Oct. 12	Oct. 12	...	Early	Effective	
Redwood	Delhi	8	Indifferent	Oct. 20	Nov. 1	Oct. 19	Late	?	
Redwood	Granite Lake	1	Active	Apr. 23	Apr. 23	Oct. 19	Early	Effective	
Redwood	Honner	5	Indifferent	Oct. 19	Nov. 2	Oct. 19	Late	...	All sick hogs died before quarantined.
Redwood	Johnsonville	10	Active	Jan. 8	May 31	June 25	Early	Effective	Cholera appeared at two different periods between dates given. All dead June 25.
Redwood	Underwood	?	Indifferent	Oct. 4	Nov. 13	Oct. 4	No quar'tine.	...	
Redwood	Swedes Forest	2	Active	Nov. 26	Dec. 22	...	...	...	
Redwood	Kintire	2	Active	Nov. 13	Dec. 18	...	Early	?	
Redwood	Vesta	6	Active	Oct. 3	Nov. 5	Oct. 3	Late	?	

Renville	Beaver Falls	5	Indifferent	Oct. 18	Oct. 18	Oct. 18	No quar'tine.		
Renville	Florita	2	Indifferent	Oct. 6	Oct. 17	Oct. 6	Late	?	
Renville	Henryville	5	Active	Oct. 6	Oct. 18	Oct. 6	Early	Effective	
Scott	Louisville	10							
Scott	Jackson	16							
Sherburne	Clear Lake	1	Active	Nov.	Nov. 2	Oct. 10	Early	Effective	
Sherburne	Haven	11	Active	Sept. 10	Nov. 5	Sept. 10, Oct. 10	Late	Not effective	Did not enforce their own regulations.
Stearns	Le Sauk	8	Indifferent	Sept. 11	Oct. 11	Sept. 11, Oct. 11	No quar'tine.		Dogs ordered tied up. Instructed Dr. Ward to send for file, but he neglected it. Even after Dr. Annand's 2nd visit report.
Stearns	St. Augusta	42	Indifferent	Sept. 10	Dec. 1	Sept. 10, Oct. 10	Late	Not effective	
Stearns	St. Cloud	20	Indifferent	July 17	Oct. 10	Sept. 10, Oct. 10	Late	Not effective	
Stearns	St. Joseph	1	Active	Oct. 16	Oct. 16		Early	?	
Steele	Bl'ming Prairie	1	Active	Aug. 3	Aug. 3		Early	Effective	
Steele	Clinton Falls	3	Indifferent	Sept. 19	Sept. 19		?	?	
Steele	Medford	2	Active	Sept. 24	Sept. 27		Early	?	
Steele	Merton	6	Active	Aug. 21	Sept. 6	Aug. 21	Late	Effective	
Wabasha	Chester	8	Indifferent	Oct. 11	Oct. 16	Oct. 16	Late	?	
Wabasha	Elgin	15	Indifferent	July 15	Sept. 15	July 15, Aug. 30	Late	Not effective	
Wabasha	Kellogg (Vil.)	1	Active	Sept. 29	Sept. 29		Early	Effective	
Wabasha	Mt. Pleasant	3							
Wabasha	Plainview	17	Indifferent	Aug. 11	Oct. 20	July 15, Aug. 30	Early	Not effective	Did not order dogs tied, nor doves shot.
Wabasha	Zumbro Falls	1							Cholera appeared at two different periods. Did not follow instructions.
Wabasha	Watopa	11	Indifferent	Apr. 20	Dec. 26	July 13			
Wabasha							Late	?	
Waseca	Iosco	3	Indifferent	Oct. 25	Oct. 25				
Watonwan	Riverdale	1	Active	Sept. 3	Sept. 24	Sept. 15	Early	Effective	
Watonwan	Rosendale	2	Active	Nov. 13	Nov. 22		?	?	
Winona	Elba	1	Active	Jan. 5	Jan. 5	June 15	Early	Effective	
Winona	Fremont	20	Active	Aug. 27	Oct. 8	Sept. 20	Early	Not effective	Cholera appeared at two different periods. Quarantined first and checked spread. Did not quarantine second time and disease spread.
Winona	Hart	25	Indifferent	May 23	Oct. 3	Aug. 24, Sept. 21			
Winona	Pleasant Hill	12	Active	Sept. 8	Dec. 4		Early	?	
Winona	Saratoga	1	Active	Sept. 28	Sept. 28		Early	?	
Winona	St. Charles	13	Active	Oct. 10	Dec. 17		Early	?	
Winona	Utica	12	Active	Oct. 13	Dec. 12		Early	?	
Winona	Warren	1	Active	Nov. 6	Nov. 6		Early		
Winona	Whitewater	3	Active	Oct. 1	Nov. 15		Early	Effective	
Winona	Wiscoy	2	Active	Oct. 12	Oct. 15		Early	Effective	
Wright	Clear Water	4	Active	Nov. 3	Nov. 21		Early	?	
Yellow Med.	Echo	16	Indifferent	Sept. 24	Oct. 9	Oct. 2	Late	?	Disease here in August. Did nothing until Dr. Annand's visit.
Yellow Med.	Posen	2	Active	Oct. 3	Oct. 4	Oct. 4	Early	Effective	

HOG CHOLERA REPORT FOR 1901.

County.	Township.	Reported Outbreaks.	Attitude of Local Health Officer.	Date of First Report.	Date of Last Report.	Date of Dr. Annard's Visit.	Outbreak Quarantined	Result.	Remarks.
Blue Earth..	City of Mankato	1	Active	Nov. 6	Dec. 5	Dec. 5...........	....	....	Hogs were shipped in from Missouri and shipped again to market. Reported by Federal Inspector.
Benton......	Langola.........	1	Active	May 2	June 6	....	June 6........	Effective.........	Owner thinks hogs were infected from corn shipped from Iowa.
Clay.........	Morken.........	1	Active	Jan. 14	Jan. 14	....	Jan. 14.......	Effective.........	
Dodge.......	Concord.........	1	Active	Dec. 23	Dec. 23	....	Dec. 23.......	Effective.........	
Fillmore	Jordon	1	Active	Feb. 23	Mar. 15	Nov., 1900........	Feb. 23.......	Effective.........	This outbreak appeared to be a continuation from 1900.
Fillmore	Harmony	1	?	Jan. 9	Jan. 9	....	....	....	Dr. Brimhall instructed board thro' the mail. Nothing more was heard from them.
Fillmore	Bloomfield	1	Active	Nov. 7	Nov. 7	Nov. 7...........	Nov. 8........	Effective.........	Outbreak in private stocky'ds of Mr. Hughes. Cholera been there three consecutive years.
Freeborn....	Albert Lea......	1	Not informed.........	Nov. 1	Nov. 5	Nov. 5...........	....	....	Ran on to it by chance while inspecting his neighbors herd.
Freeborn....	Freeman........	1	Active	Jan. 9	Jan. 9	....	Jan. 9........	Effective..	
Freeborn....	Nunda	1	Active	Apr. 3	Apr. 3	....	Apr. 3........	Effective.........	
Hennepin....	Richfield........	1	Active	Feb. 19	Mar. 4	....	Mar. 4........	Effective.........	
Lyon	Grand View	1	Indifferent	Oct. 19	Oct. 27	Oct.27, Dr. Brimhall	Oct. 27.......	Effective.........	
Lyon	Monroe..........	1	Not informed.........	Dec. 31	Jan. 3	Jan. 3...........	Jan. 3........	Effective.........	Hogs were shipped and sold for slaughter. Reported by Federal Inspector.
Martin......	Manyaska.......	2	Indifferent	Oct. 29	Nov. 4	Oct. 29..........	Nov. 1.......	Effective.........	
Martin......	Elmcreek.......	1	Active	Oct. 29	Oct. 29	Oct. 29..........	Nov. 2........	Effective.........	
Martin......	Jay.............	4	Active	Oct. 29	Dec. 10	Oct. 29..........	Nov. 2........	Effective.........	
Martin......	Fox Lake	2	Active	Oct. 26	Dec. 6	Oct. 29..........	Oct. 26.......	Effective.........	
Mower	Lansing.........	2	Indifferent	Sept. 30	Oct. 8	Oct. 8...........	Oct. 8........	Effective.........	
Mower	Udolpho.........	1	Active	Nov. 23	Nov. 23	....	Nov. 23......	Effective.........	
Nicollet.....	Courtland.......	1	Indifferent	Nov. 22	Nov. 22	Nov. 22.........	Nov. 22......	Effective........	
Nicollet.....	Traverse........	1	Indifferent	Nov. 16	Mar. '02	Nov. 22.........	Nov. 22......	Effective.........	
Nobles	West Side.......	12	Indifferent at first....	Oct. 1	Nov. 23	Oct. 15..........	Oct. 16.......	Effective.........	This outbreak was allowed to spread before the supervisors took action.
Nobles	Lismore.........	14	Active	Oct. 1	Dec. 2	Oct. 15......	Oct. 12.......	Effective.........	This outbreak was allowed to spread before the supervisors took action.

Nobles	Leota..........	4	Indifferent	Oct. 15	Oct. 30	Oct. 15..........	Oct. 16.......	Effective.........	Fortunately this outbreak did not spread.
Nobles	Ellsworth (Vill.)	1	Indifferent	Sept. 24	Oct. 1	Oct. 1, Dr. Brimhall	....	....	
Olmstead....	Pleasant Grove.	1	Active	Sept. 10	Sept. 16	....	Sept. 14......	Effective.........	
Ramsey	City of St. Paul.	1	Active	Dec. 7	Dec. 7	....	....	Effective.........	Hogs were slaughtered.
Ramsey	Rose............	1	Active	....	....	....	....	....	At Experiment Station.
Renville.....	Troy	1	Active	Aug. 24	Aug. 29	Aug. 27..........	Aug. 29......	Effective.........	
Renville.....	Beaver Falls....	2	Active	Nov. 5	Nov. 24	Nov. 11..........	Nov. 11......	Effective.........	
Renville.....	Bird Island.....	1	Not informed.........	April	Aug. 27	Apr. 12, Dr. Brimhall	....	....	Reported by Dr. Ketchum, Federal Inspector So.St.Paul.
Renville.....	Winfield	1	Active	Sept. 4	Sept. 4	....	Sept. 4.......	Effective.........	
Scott	Sandcreek	3	Active	May 5	Nov. 30	....	May 22.......	Effective.........	
Scott	Helena	1	Active	Dec. 3	Dec. 3	....	Dec. 3........	Effective.........	
Stearns......	Le Sauk.........	1	Active	July 20	July 20	July 20, Dr. Ward	July 20.......	Effective.........	
Wabasha ...	Glasgow	2	Active	Oct. 10	Oct. 10	....	Oct. 10......	Effective.........	
Wabasha ...	Greenfield	1	Not informed.........	Dec. 26	Jan. 2	Jan. 2 '02 Dr. Brimhall	Jan. 2, 1902..	Effective.........	Reported by owner.
Waseca......	Iosco	5	Active	Nov. 10	Nov. 10	....	Nov. 10......	Effective.........	
Winona	Warren	1	Active	June 6	June 6	....	Nov. 6.......	Effective.........	
Yellow Med.	Sioux Agency...	2	Active	June 18	June 29	July 12..........	June 29.......	Effective.........	

HOG CHOLERA REPORT, 1902.

County.	Township.	Reported Outbreaks.	Attitude of Local Health Officer.	Date of First Report.	Date of Last Report.	Date of Dr. Annand's Visit.	Outbreak Quarantined.	Result.	Remarks.
Blue Earth	South Bend	1	Active	May 6	May 14	May 14	May 14	Effective	
Blue Earth	Butternut Val.	3	Not active	Nov. 12	Nov. 12	Nov. 12	No	Died out	Disease spread from Lincoln Tp.
Blue Earth	Lincoln	4	Not active	Nov. 12	Nov. 12	Nov. 12	No	Died out	Disease died out after a great many farmers lost most of their hogs.
Big Stone	Big Stone	1	Active	Dec.29,'01	Jan. 8	Jan. 8, Dr. Brimhall	No	Died out	Swine plague. Health officers had charge of outbreak.
Chisago	Chisago	1	Not notified	Sept. 20	Sept. 27	Sept. 23	Sept. 23	Effective	Evidently got infection at S. fair.
Chippewa	Sparta	3	Indifferent	Sept. 18	Oct. 2	Oct. 2	No	Died out	Two farms had disease early in year and died out; only one farm infected Oct. 2.
Dakota	Burnsville	5	Indifferent	Nov. 4	Nov. 8	Nov. 7	No	Died out from Isolation	Disease appeared in township in July.
Fillmore	Preston	4	Active	Oct. 7	Nov. 12	Oct. 14 and 28	Oct. 28	Effective	
Fillmore	Carrollton	4	Indifferent	Oct. 14	Nov. 5	Oct. 14 and 28	Nov. 28	Died out	
Freeborn	Carlston	5	Indifferent at first	Oct. 15	Nov. 20	Oct. 16 and 30	Oct. 17	Died out	
Freeborn	Freeborn	7	Indifferent at first	Oct. 16	Oct. 28	Oct. 16 and 30	Oct. 17	Died out	
Freeborn	Albert Lea	4	Indifferent	Oct. 30	Oct. 30	Oct. 30	No	Died out	
Freeborn	Bancroft	3	Active	Nov. 6	Nov. 12	Oct. 30	Nov. 11	Effective	
Freeborn	Hayward	1	Active	Dec. 16	Dec. 16		?	Effective	
Freeborn	Alden	1	Active	Oct. 16	Oct. 16	Oct. 16	Oct. 16	Effective	
Houston	La Crescent	5	Active	Apr. 17	May 15	Apr. 8, Dr. Brimhall	Apr. 17	Effective	This outbreak came from Wis.
Jackson	Evington	6	Active	Oct. 13	Nov. 28		Oct. 13	Effective	
Jackson	Hunter	8	Indifferent	Dec. 3	Dec. 10	Dec. 3	Dec. 8	Effective	
Jackson	Jackson City	1		Jan. 6	Feb. 3			Effective	Stock yards.
Lyon	Monroe	1	Not notified	Jan. 3	Jan. 3	Jan. 3	Jan. 3	Effective	
Martin	Manyaska	1	Active	Feb. 21	Feb. 21		Feb. 21	Effective	These outbreaks originated on the farm of Daniel Page, who allowed his hogs to run all over the neighborhood; also left his dead hogs unburied. He was prosecuted Nov.29,'02.
Martin	Pleasant Prai'e	7	Indifferent	Oct. 15	Oct. 30	Oct. 15 and 29	Oct. 30	Effective	
Mower	Frankford	1	Active	May 23	May 23		May 23	Effective	
Nobles	Hersey	3	Active	Sept. 20	Oct. 27	Oct. 8-9, Dr. Brimhall	Oct. 13	Effective	
Nobles	Lismore	2	Active	Nov. 15	Dec. 4	Dec. 4	Nov. 15	Effective	
Nobles	Loraine	1	Active	Sept. 27	Sept. 29	Oct. 8-9, Dr. Brimhall	Sept. 27	Effective	
Pipestone	Pipestone	1	Indifferent	Dec. 3	Dec. 3		?	?	
Ramsey	Rose	1	Not notified	Dec. 29	Dec. 29				This outbreak was at the state farm. Infected while at Chicago stock show.
Ramsey	Mounds View	1	Active	Apr. 1	Apr. 2		Apr. 2	Effective	
Ramsey	New Brighton Vil.	1	Active	Jan. 8	Jan. 8	Jan.	Jan. 8	Effective	
Rock	Battle Plaine	2	Active	Dec. 4	Dec. 6	Dec. 4	Dec. 5	Effective	
Rock	Vienna	4	Indifferent	Dec. 1	Dec. 4	Dec. 4	Dec. 1	Died out	
Wabasha	Highland	1	Indifferent	May 26	May 26		?	Died out	
Wabasha	Glasgow	2	Indifferent	May 26	May 26		?	Died out	

HOG CHOLERA REPORT, 1903, TO APRIL 21st.

County.	Township.	Reported Outbreaks.	Attitude of Local Health Officer.	Date of First Report.	Date of Last Report.	Date of Dr. Annand's Visit.	Outbreak Quarantined.	Result.	Remarks.
Becker	Lake Park	1		Jan 15					Outbreak originated from hogs that were exhibited at Chicago stock show.
Chippewa	Havelock	1	Active	Apr. 7	Apr. 13		Apr. 13	Effective	
Douglas	Alexandria	1		Jan. 30	Feb. 9	Feb. 3			From hogs that were taken from R. R. stockyards.
Dakota	Burnsville	2	Active	Jan. 9	Jan. 9		Jan. 9		From 1902 outbreak.
Freeborn	Freeborn	1	Active	Feb. 2	Feb. 2		Feb. 2		From 1902 outbreak.
Fillmore	Amherst	1	Active	Jan. 7	Jan. 7		Jan. 7		From 1902 outbreak.
Jackson	Hunter	1	Active	Feb. 9	Feb. 9		Feb. 9		
Hennepin	Eden Prairie	1	Active	Jan. 23	Feb. 6	Feb. 6	Feb. 1		
Hennepin	St. Anthony	1	Inactive						
Hennepin	Richfield	1	Active	Jan. 17	Mar. 4		Jan. 17		From 1902 outbreak.
Nobles	Summit Lake	1	Active	Feb. 26	Mar. 26		Mar. 26		From 1902 outbreak.
Nobles	Lismore	2	Active	Feb. 2	Feb. 2		Feb. 2		
Ramsey	Mounds View	1	Active	Feb. 13	Feb. 16		Feb. 16		Outbreak originated from hogs that were exhibited at Chicago stock show.
Clay	Eglon	1							

Laboratory Investigations. Besides the work of the board above reported in the diagnosis and quarantine of hog cholera and swine plague, the following special investigations have been made by the Veterinary Department and the Laboratory:

State Experiment Station.—On Jan. 15, 1901, there was received in the laboratory from Dr. M. H. Reynolds, of the State Experiment Station, the liver, lung, heart, spleen, kidney and several feet of small intestines of a pig, which had died the morning of January 14th and had been examined post-mortem by Dr. Reynolds on the evening of the 14th. Accompanying the specimen was the following note from Dr. Reynolds:

Jan. 14, 1901.

Dr. F. F. Wesbrook, University,

Dear Doctor: These specimens came from a mature hog, which died this forenoon, after several days of apparently slight indisposition. The death was rather sudden and unexpected. Examination post mortem revealed mainly a general and most intense enteritis. The intestines contained a considerable quantity of what appeared to be mainly blood. A very extensive effusion of peculiar inky red serum in both cavities, but pleuritis and peritonitis not especially marked in abdomen and thoracic walls. Liver soft, friable, wet, its anterior surface covered by small, grayish patches of recent exudate. Kidneys apparently normal. Spleen, normal size, soft. Lungs show a general broncho-pneumonia with pleuritic exudate on surface. Examination of superficial subcutaneous tissues showed two areas (one in each groin) resembling those found in hemorrhagic septicaemia.

Another subject examined post-mortem today—dead about 36 hours—showed one lung with a small, clearly-defined area which looked very much like areas seen in lungs of swine plague subjects; but the other lung showed a general broncho-pneumonia. Cæcum near valve showed pits which might have been those of hog cholera ulcers, but the intestine was in poor condition for examination and I could not be certain.

M. H. REYNOLDS.

When received in the laboartory all the specimens were filled with gas bubbles and gave off a marked odor of decomposition. Direct coverslip preparations from all the organs, except the intestines, showed large numbers of short, thick, spore-bearing bacilli, apparently unmixed with other bacteria. Cultures were made in duplicate in broth, on serum, plain agar, litmus lactose agar and litmus glucose agar from the spleen, liver and lung. These were grown at room and incubator temperature, ærobically, but no growth developed on any of the cultures at any time. Cultures were made in glucose glycerine broth and in glucose agar, which were grown anærobically, at incubator temperature, and others in glycerine glucose broth, which were grown anærobically, at room

temperature. All these developed pure cultures of the large spore-bearing bacillus, apparently the same as that observed in direct coverslip preparations. The organism grew well at both room and incubator temperature, developed abundant gas, was non-motile and apparently strictly anærobic. What was its relation to the disease process in the animal from whose organ it was taken is doubtful. Swine plague or hog cholera bacilli, if originally present, must have been destroyed either by the growth of this organism of some other agency.

State Experiment Station.—Jan. 19, 1901, Dr. Wilson collected direct coverslip preparations and cultures from the tissues and organs of the second pig dead of supposed hog cholera at the State Experiment Station. Dr. M. H. Reynolds conducted the autopsy. Direct coverslip preparations, stained with eosin and methylene blue, showed from the—

(a) Lung, no bacteria.
(b) Heart's blood, (1) bacteria resembling swine plague, that is, with polar granules; (2) bacteria resembling hog cholera bacilli.
(c) Liver, (1) bacteria resembling capsulated diplobacilli, or diplococci (more like cocci); (2) bacilli resembling swine plague bacilli; (3) large growth of cocci (capsulated).
(d) The spleen, (1) bacilli resembling swine plague bacilli, or small diplococci; (2) thick capsulated bacilli.
(e) The kidney, many red blood cells, a few coarsely granular or hyaline cells, many epithelial cells and phagocytes filled with bacilli like swine plague bacilli or diplococci.

Aerobic cultures from lung: Hanging drop broth showed many small, short, non-motile bacilli, some in chains or two or three pairs (swine plague?); also a few larger bacilli about the size of colon bacilli, actively motile.

Stained preparations from agar showed apparently pure cultures of swine plague (?) bacilli. Heart's blood, hanging drop from broth, no growth; stained preparations from serum and broth, no growth; liver, no growth in broth cultures; on serum, large square-ended bacilli, probably *B. subtilis*; spleen, hanging drop broth, all bacilli seemed to be motile, apparently the large and small varieties of diplo-bacilli. Preparations from agar from the small colony showed bacilli somewhat like swine plague. From the large colony small, colon-like bacilli; kidney, hanging drop broth, motile, slender bacilli, somewhat like colon or a trifle larger (hog cholera?). Prep-

arations from broth, slender, rather long bacilli, somewhat colon-like.

Incubated, anærobic cultures from lung, liver, heart's blood, spleen and kidneys showed growth only from lung and spleen. Cultures from these organs were apparently pure, of small diplococcoid bacilli (swine plague). Cultures from single colonies were streaked out in litmus lactose agar, after 24 hours' growth. Seven of those resembling, morphologically, swine plague or hog cholera bacilli, sown on the various media on which they were all easily identified, as follows: From the lung and spleen, *B. suisepticus*; the spleen, *B. choleræ suis* and *B. coli communis*; from the kidney, *B. coli communis* only.

State Experiment Station.—Monday, Jan. 28, 1901, specimens were collected by Dr. Wilson from a pig dead eight hours before, after a short illness, at the State Experiment Station. The animal was a three-months-old Tamworth, weight 50 to 70 pounds. Externally the skin of abdomen showed numerous minute, purplish points. In removing the skin from the animal very many pin-point ecchymotic areas were found scattered throughout the subcutaneous and superficial muscles over the entire body. In addition to this, on the extremities, in the groins and along the back were large hemorrhagic areas. One on the left groin was an area 15 c. m. in diameter, consisting of numerous hemorrhages which had coalesced. The subcutaneous tissue was infiltrated with yellow serum. The inguinal and cervical glands were all enlarged to several times their normal size in diameter throughout. A similar condition of the glands in the internal regions of the body was also present. The pericardium contained small hemorrhagic areas; also the wall of the heart had numerous hemorrhages. The lungs were typical "swine-plague" lungs, i. e., contained large collapsed areas of a dark red color. The stomach and intestinal walls contained numerous small, thickly set ecchymoses. Liver was normal; the spleen was swollen, dark and soft. The cortex of the kidneys was specked with minute ecchymoses; the bladder wall was swollen and black, with hemorrhages throughout its entire extent; the urine was dark red.

Coverslip preparations from the inguinal glands, heart's blood, lung, spleen and liver all showed numerous swine plague (?) bacilli.

Cultures in broth on serum and plain agar gave abundant growth of swine plague bacilli from the inguinal gland, lung, heart's blood, spleen, liver and urine.

State Experiment Station.—Jan. 31, 1901, Dr. Wilson collected specimens from two pigs on which autopsies were performed by Drs. Reynolds and Brimhall, at the State Experiment Station. Pig No. 1, a female Tamworth, weighing about 60 pounds, had been ailing for some time, but died suddenly on the morning of January 31st. Numerous small purplish spots were present over the skin of abdomen. Scattered over the subcutaneous tissues, over the entire body and throughout all of the internal organs were numerous small ecchymoses. No large hemorrhagic areas were present, except some from one-half to one inch in diameter about the digits and the posterior extremities. Several ulcers about one c. m. in diameter were present in the sacrum.

Direct coverslip preparations from lungs, heart's blood, spleen and liver showed a few small diplococcoid bacilli. Cultures in broth, on serum and on agar, showed from the lungs swine plague bacilli unmixed with other organisms. From the spleen and liver, swine plague bacilli associated with hog cholera bacilli.

A second pig, which was examined on the same day, was a male Tamworth, weight 150 pounds. Animal had been sick several days and had died but a few hours before the autopsy. The anatomical lesions were parallel with those noted in the first pig. Direct coverslip preparations and cultures gave parallel results, i. e., swine plague bacilli from the lung and swine plague and hog cholera bacilli from spleen and liver.

State Experiment Station.—Feb. 11, 1901, at 2 p. m., Drs. Wesbrook and White collected specimens from the various organs and tissues of a Yorkshire sow, No. 250, which had died late at night February 9th, and concerning which they made the following autopsy notes: Pleural cavities contained some fibrinous exudate; pericardial cavity, slight fibrinous exudate; considerable fluid; the pericardium showed a few small petechiæ; left lung at the anterior end showed a large area of hemorrhage with whitish areas (abcesses); few small pin-head sized white raised spots with a hemorrhagic ring about them. Similar but smaller areas on the anterior end of the right kidney; numerous pin-point white areas beneath the capsule; skin lesions were petechial hemorrhages especially well marked about the buttocks.

Direct coverslip preparations stained with eosin and methylene blue from the lung showed diplococci, small, belted, ovoid bacilli and large putrefactive organisms; from the heart's blood, nothing; from the spleen, same as the lung, except no diplococci; from the liver, same as spleen.

Broth and serum cultures from all the organs developed swine plague bacilli, and from the spleen and liver, hog cholera bacilli. These were mixed with staphylococci, *B. coli communis* and a large liquefying bacillus, probably contaminations.

State Experiment Station.—Feb. 11, 1901, at 2 p. m., Drs. Wesbrook and White collected specimens from the body of a Yorkshire sow, No. 775, which had died February 9th, late at night, and concerning which the following autopsy notes were made at the time:

Skin generally filled with small petechiæ. Large patches with hard, dried skin (necrosis) over each quarter and on back of neck. Extensive small hemorrhages into subcutaneous fat of ventril midline. Large patches seen externally correspond to extensive hemorrhagic and necrotic areas in subcutaneous tissues. One area of necrosis on side does not show externally. Hemorrhages well shown over both hocks. Lungs showed many areas solid and grayish, raised. Some larger areas, solid, dark and depressed. Pericardium contained a few petechiæ. Large intestines showed minute ulcers in cæcum near valve.

Direct coverslip preparations, stained with eosin and methylene blue, from the spleen and liver, lung and heart's blood, all showed large, putrefactive bacilli and a few showed cocci.

Cultures in broth and on serum from the various organs noted above developed staphylococci, *B. coli communis* and one liquefying organism. *B. suisepticus* was present in the heart's blood and lung; *B. choleræ suis* was found in the spleen.

State Experiment Station.—July 9, 1901, there was received in the laboratory from the State Experiment Station a pig killed one hour before, when almost dead, and the heart and lungs of a second pig dead about three hours before. Animals were about four or five weeks old and had been sick but a very short time. The one brought to the laboratory was in excellent condition. The lungs, which had already been removed from the body of pig No. 1, showed typical alternating red and gray spotted "lung of swine plague." The heart wall and pericardium showed no lesions. Complete autopsy on the body of pig No. 2 showed the same appearance of the lung as that noted in pig No. 1. In addition there was considerable effusion of straw-colored serum into the pericardium and a few minute ecchymoses of the heart wall. No other gross lesions were discovered in any portion of the body.

Direct coverslip preparations and cultures in broth and on serum were made from the lung, pericardial fluid and heart's blood.

Direct coverslip preparations (stained with eosin and methylene blue) showed from the lung a few small diplococcoid bacilli; those from the pericardial fluid and heart's blood showed no bacteria.

Cultures on serum and in broth from the lung gave a fair growth of a small diplococcoid bacillus apparently unmixed with other organisms. This organism, when grown on the various media, proved to be *B. suiscepticus.* No bacteria grew in any of the cultures from the pericardial fluid or heart's blood.

Ghent, Minn.—Oct. 29, 1901, Drs. Brimhall and Wilson visited the farm of Mr. J. P. Smiley, three miles south of Ghent, Minn., and made autopsies on the bodies of two shoats, one dead about an hour and the other killed for purposes of autopsy. These animals were the first noticed by the owner to be affected with hog cholera. His neighbor had recently lost 70 hogs with the disease, which was, presumably, communicated to Mr. Smiley's herd through carelessness on the part of the neighbor in permitting his animals to range along a creek which flowed thence through Mr. Smiley's farm. At autopsy of the two animals, small ecchymotic areas were found subcutaneously and a very few in some of the internal organs. The chief lesions, however, were those of the lungs, which presented large, "collapsed," purplish red areas in marked contrast with the white, normal lung, the typical "swine plague" lung. The spleen of pig No. 2, the one killed for autopsy, was enormously enlarged. Direct coverslip preparations, broth and serum cultures, were made from the lung, pericardial fluid, heart's blood and spleen of each of these animals.

The direct coverslip preparations from the lung showed a very few diplococcoid bacilli. Those from the other organs and tissues showed no bacteria. Cultures from pig No. 1, which had been dead an hour before the autopsy was performed, showed small diplococcoid bacilli—*B. suisepticus*—from the lung and spleen. In addition in the spleen were found larger, colon-like bacilli, proven later to be *B. choleræ suis.* These were also present in cultures from the pericardial fluid and heart's blood. Of pig No. 2 the cultures from the pericardial fluid, heart's blood and spleen remained sterile. Those from the lungs showed small diplococcoid bacilli only—*B. suisepticus.*

Detroit, Minn.—Jan. 1, 1903, there was received in the laboratory two quart Mason's jars containing pieces of tissue. These specimens were accompanied by absolutely no data. Consequently one week elapsed before it was possible to get sufficient data to determine that they came from Dr. A. Youngberg, Detroit, Minn., who

had removed the specimens from a pig dead of supposed swine plague or hog cholera.

The data supplied by Mr. Youngberg is as follows:

"Hogs presented the following symptoms before death: Two weeks before death they began to cough and lose their appetite and have a slight attack of diarrhoea. The faeces were of a clay color. These symptoms increased in severity until about 24 hours before death, when they commenced to breath very rapidly, the respirations being about 28 per minute and very laborious. Two or three hours before death there was hemorrhage from both nostrils.

"At autopsy the lungs were found more or less hepatized; mediastinal pleura was of a mahogany color; the liver and kidneys seemed all right. This is, properly speaking, an infectious lung disease, but it did not act exactly like swine plague. I rinsed the jars in boiling water and as I opened the thoracic cavity I cut off a few pieces and put them in."

The specimens had been kept constantly frozen and on January 7th the jars were removed from them and the specimens examined. Direct coverslip preparations and cultures were made and examined. The specimens consisted of a portion of heart, lung, spleen and liver. The results of the bacteriological examinations, after numerous cultures and sub-cultures, were as follows:

(a) *Lung.*—From the lung were isolated—
1. *B. suisccpticus* (swine plague bacillus).
2. A. gram-staining diplococcus (probably diplococcus pneumoniæ).
3. *B. coli communis.*

(b) *Heart.*—From the heart was isolated—
1. *B. pyocyaneus.*

(c) *Spleen.*—From the spleen were isolated—
1. *B. suisepticus* (swine plague baccillus).
2. *B. coli communis.*

(d) *Liver.*—From the liver was isolated—
1. *B. coli communis.*

Fifty-four individual colonies from the lung and spleen were studied to determine if perchance any of them were *B. choleræ suis.* All turned out to be typical *B. coli.* Thus while *B. choleræ suis* was not absolutely excluded, the probability of its presence in the lung and spleen is small.

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Besides the above examinations made since the last Biennial Report was issued, there should be reported from the laboratory the following experiments, which were conducted in 1896, but which were inadverently omitted from previous reports:

Shortly after the first work done in the laboratory on the Widal reaction for typhoid fever in man, an attempt was made to determine whether a serum reaction existed for hog cholera. A pure culture of *B. choleræ suis* was inoculated into the ear vein of a half grow male rabbit, Dec. 5, 1896, and blood was collected twice daily thereafter and the reaction tested. No reaction was present in the serum at any time during the 48 hours that the rabbit lived. At autopsy of the rabbit the inoculated bacteria were recovered from the liver, spleen, lung and heart's blood.

Dec. 5, 1896, an eight-months-old male guinea pig was inoculated subcutaneously with 1 c. c. of a 24-hour broth culture of *B. choleræ suis.* A specimen of blood taken previous to the inoculation showed no reaction. Blood was tested again as follows:

December 6th, at 11 a. m.—Reaction absent.
December 7th, at 6 p. m.—Reaction absent.
December 8th, at 10 a. m.—Reaction slight.
December 9th, at 10 a. m.—Reaction present.
December 10th, at 9 a. m.—Reaction present.
December 11th, at 4 p. m.—Reaction present.
December 12th, at 5 p. m.—Reaction present.

Animal died during night of December 12th. At autopsy *B. choleræ suis* was obtained from the site of inoculation, kidney, spleen, lung, liver and heart's blood.

Dec. 16, 1896, blood was collected from eight apparently normal hogs at the Stock Yards in St. Paul. This blood was tested with a pure culture of *B. choleræ suis* with negative results in each case.

Pressure of other work at this time and inability to secure blood from hogs suffering from hog cholera prevented the continuance of these experiments, and Feb. 20, 1897, Dr. Dawson, of the Bureau of Animal Industry, published in the New York Medical Journal a preliminary report on similar experiments.

During May, 1897, several specimens of blood from hogs supposedly affected with hog cholera were examined in the laboratory, but with negative results in each case. At the same time there were being conducted in the laboratory a series of experiments testing the virulence of *B. choleræ suis* from various sources on guinea

pigs, rabbits, rats and mice. It was found in all of these experiments that were *B. choleræ suis* had been injected into laboratory animals that at autopsy the bacteria were present not only in the tissues and glands, but also in the blood stream. Therefore, despite the possibility of the development of a method of diagnosis by means of a serum reaction for hog cholera, experiments along this line were not continued because (1) a clinical diagnosis of hog cholera may be made with a fair degree of accuracy, and, (2) since the specific bacteria are present in the blood stream of infected animals the disease might possibly be spread from the blood during collection and transit.

Summary.—The laboratory work in connection with hog cholera and swine plague has been limited because there was little demand for investigation in connection with outbreaks of a disease in which the clinical diagnosis is readily made. In the matter of a curative or protective serum, work was not carried on extensively, since this matter has engaged the attention of the Bureau of Animal Industry for a number of years with relatively small return.

It was hoped in the event of the continuance of the study of infectious diseases of animals that light could be thrown upon this question in connection with the work on hemorrhagic septicæmia in cattle and swamp fever in horses. Collaboration between the veterinary department and the laboratory has, however, shown, so far as the investigations have been carried forward:

1. The usual association of swine plague and hog cholera bacilli, especially after the initial cases of an outbreak.

2. In certain instances swine plague bacilli only were found, particularly in initial cases.

3. In one instance* hog cholera bacilli were found in salted pork which had been responsible for severe gastric disturbances in human beings.

4. Experiments were early undertaken towards formulating additional means of diagnosis in the examination of blood of suspected cases for the agglutination test (Widal reaction).

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*State Board of Health Biennial Report, 1899–1900, p. 447.

TRICHINOSIS.

But little opportunity has been given for the study of this disease in Minnesota. A few recorded facts, however, are of interest.

During December, 1900, and January, 1901, a family of Germans, consisting of father, mother, ten children, living on a farm in New Sweden Township, Nicollet County, and two married daughters, ate of sausage made from hogs raised on their own farm. The first symptoms of the disease appeared Dec. 19th. The disease was first diagonsed as trichinosis by Dr. W. A. Beach of Mankato, Dec. 29th, when he was first called to see the cases. There were eight severe cases of trichinosis in this family, five of which were fatal. Four others had mild symptoms of trichinosis, but recovered. The father, eldest daughter, and son were the first members of the family to become ill, and a few days later one married daughter also had mild symptoms of the disease. The eldest daughter, M., died Dec. 29th, the father died Jan. 1st, and one son, G., died Jan. 5th. The mother also died in January, and another son, F., Feb. 12th. The infection of this family undoubtedly came from their own hogs, which had been slaughtered Nov. 28, 1900. These hogs had been raised and fed on the farm. So far as external evidence demonstrated the animals were all in good flesh and health at the time of slaughter. The family ate of the sausage made from these hogs as early as Dec. 3rd. The source of infection of the hogs was in all probability from rats, which were very numerous about the barns. The pen in which the hogs were fattened was within ten yards of the corn crib, and twenty yards of the barn.

The attention of the State Board of Health was first drawn to this family under date of Dec. 31, 1900. On the evening of Jan. 1, 1901, Dr. Wilson, bacteriologist from the State Board of Health Laboratory, in company with Dr. W. A. Beach of Mankato, visited this family. An autopsy was made on the body of the father, who had been dead twenty-four hours. No gross lesions were found in any of the organs except marked softening and flabbiness of the heart muscle, apparent fatty degeneration of the liver and small ecchymotic areas on the surfaces of the spleen and kidneys. The spleen, left kidney, portion of the right lung, apex of heart and portions of muscles from the left rectus of the abdomen, the diaph-

ragm, intercostal muscle from fifth inter space (right side), larynx, right biceps and right quadraceps extensor, together with enlarged retroperitoneal glands were collected and brought to the laboratory. A piece of summer sausage from the same lot as that eaten by the family was also brought to the laboratory.

The autopsy was made under extremely difficult conditions in a small room, badly lighted by a single kerosene lamp and crowded with neighbors, who had to remain in the room on account of the intense cold out of doors. From the history, symptoms and autopsy findings, a provisional diagnosis of trichinosis was made at the time and the quarantine which had been imposed on the supposition that the cases were small pox was raised. Owing to the extreme cold, the excited condition of the numerous neighbors who had flocked to the house, and the necessity of economizing time as much as possible in order to reach Nicollet for an early morning train, specimens for routine blood examinations were not collected.

Within two hours after Dr. Wilson arrived in the laboratory with the specimens, January 2nd, a verification of the diagnosis of trichinosis was made by microscopic examination of the tissues collected at autopsy, numerous trichinæ being found in the specimens of muscle from the various sources noted above. Later examination of portions of muscle selected from the sausage also showed encysted trichinæ spiralis.

Another death from trichinosis occurred in a child two years of age in Waldon Township, Polk County, Oct. 5, 1902. The attention of the board was not drawn to this case, and it therefore received no investigation.

Mankato, Minn.—Four specimens of pork forwarded by Aug. C. Arneman, No. 324 E. First Street, Mankato, Minn., to Dr. Bracken, on Feb. 11, 1901, were received in the laboratory February 14th. Three small pieces of pork were contained in the packet, which was accompanied by a letter from Mr. Arneman requesting an examination for trichinæ. This was made, but no trichinæ were found.

Sandstone, Minn.—Jan. 7, 1902, there was received in the laboratory by mail, through Dr. M. H. Reynolds' office, a package containing pork. This had been sent by Dr. D. W. Cowan, accompanied by the following letter:

Sandstone, Minn., Jan. 1, 1902.

Dr. N. M. Reynolds, Secretary State Veterinary Board, St. Anthony Park, Minn.

Dear Sir: I have forwarded you to-day a sample of pork which was brought me, and the party bringing it said he had reasons of suspecting trichina being present.

Have forwarded the sample to you, as I do not know what else to do with it

Respectfully,

D. W. COWAN, H. O.,
Sandstone, Minn.

The sample of pork was dry and covered with mould, having been simply wrapped in several thicknesses of paper and forwarded. Thin sections were cut from various portions of the lean pork sent and examined in glycerine with low power objectives. No trichinæ were found.

New Ulm, Minn.—Feb. 5, 1903, there was received in the laboratory a sample of pork. Concerning it the following letter had been received two days previously:

Dear Dr. Wesbrook: I send you by this mail a sample of pork for examination as to the presence of trichina. The sample was brought in by a farmer.

Fraternally yours,

A. F. STRICKLER.

On its arrival the specimen was carefully examined and no trichinæ found.

Hutchinson, Minn.—May 23, 1903, there was received in the laboratory a specimen of pork accompanied by the following letter:

Hutchinson, Minn., May 21, 1902.

Dear Sir: You will find enclosed a sample of cooked pork, which I believe to be infected with trichina, that bane of mankind. Will you kindly subject it to a critical test and mail me the results of your investigation? I obtained the sample from some meat that was used at my hotel.

Yours sincerely,

EBEN E. BUTLER.

The specimen consisted of a fragment of cooked meat. It was examined by teasing out portions of the dry muscle in glycerine and examining microscopically. Nothing resembling trichinæ spiralis was found.

LABORATORY REPORT ON SUNDRY OBSCURE DISEASES OF SWINE.

Hugo, Minn.—May 25, 1901, Drs. Brimhall and Wilson visited the farm of Mrs. Wilcox near Hugo, to investigate the cause of death of one pure bred hog. Unfortunately the animal had been cut open by the hired man and had been exposed so long to the air that an examination of the carcass was useless. From the history of the case it was possible to say positively that the disease was not hog cholera and as this was what the owner was especially in fear of, this assurance was appreciated. Later this opinion proved to be well founded as nothing further developed in the herd.

May 29, 1902, Dr. Brimhall again went to Mrs. Wilcox's farm to investigate a disease among pure bred hogs which was supposed to be of an infectious nature. Only one animal was found affected and this was not in a serious condition.

West Concord.—April 2, 1902, there was received in the laboratory a specimen accompanied by the following letter:

West Concord, Minn., April 2, 1902.

Dr. F. F. Wesbrook, Minneapolis,

Dear Doctor: I send you by express today a portion of the large intestine of a hog. The hog had every appearance of being all right, but the farmer owning the same is afraid of the meat on finding the bowel on this condition. Can you tell the cause of this condition? Will the meat be fit to eat?

Yours fraternally,

E. E. HARRISON.

The specimen consisted of a small portion of the small intestine of a hog, placed in a diphtheria box without any packing. It was examined macroscopically by Dr. Brimhall and the laboratory staff. The intestine was unopened and attached to it was a piece of mesentery. On the peritoneal surface of the intestine were numerous smooth bullæ or gas bubbles, some of which appeared to be in the mesenteric tissue. There was some congestion and possible œdema of the bowel also. It did not seem possible that manipulation could have created an interstitial emphysema such as this appeared to be. The lesion may have been due to *B. coli communis* or to some ærobic gas-producing bacillus. The specimen was in no condition to examine macroscopically or bacteriologically and an accurate diagnosis was out of the question.

Long Lake, Minn.—Jan. 11, 1903, Mr. F. R. Hubachek, whose farm is near Long Lake, Minn., sent to the laboratory a pig, one of three which had died on his place. The symptoms first noted were fainting spells from which some of them would apparently recover after being rubbed. They were noticed bleeding a little from the nose after the spells. They exhibited these symptoms for a week before they died.

The one that was received in the laboratory was partially frozen and in very good condition. An autopsy was made at once by Drs. Brimhall and Wilson. There were no lesions indicating either swine plague or hog cholera or any other specific disease. The lungs were slightly congested, probably from hypostasis. One post pharyngeal gland was slightly hæmorrhagic but not enlarged.

Direct coverslip preparations and broth and serum cultures from both lungs and spleen showed no bacteria. It was the opinion of Dr. Brimhall that the pigs were dying from close crowding coupled with heavy grain feeding.

St. Cloud Reformatory, St. Cloud, Minn.—On March 20, 1903, there was received in the laboratory a two-quart glass jar containing a large portion of liver in a mixture of formaldehyde and alcohol. Accompanying the specimen was the following letter from Dr. O. H. Wolner of the St. Cloud Reformatory:

St. Cloud, Minn., March 13, 1903.

Dr. Wilson, Minnesota University, Minneapolis,

Dear Doctor: Enclosed please find a specimen of liver taken from a boar which apparently died suddenly, but of course did not, as the post-mortem findings showed, which are as follows:

Kidneys apparently normal.

Lungs and heart normal.

Spleen enlarged, friable and congested, of a black appearance.

Intestines showed peritonitis but not inflammation of the mucous membranes.

Peritoneal adhesions between the coils of the intestines (small).

Between the peritoneum and the peritoneal fat were four or five cysts containing a clear, gellatinous fluid; in the immediate vicinity were numerous adhesions and three small localized abscesses.

Liver.—The liver was greatly enlarged and extremely friable and covered with small white areas which when opened seemed to be air spaces. Peritoneal fluid was normal in amount.

We have had fifteen hogs die of the same disease, and if you could enlighten us we would be greatly obliged to you. In some of the hams that were cured last fall localized abscesses in the lymphatic glands were found.

I am, dear doctor,

O. H. WOLNER, M. D.

The liver specimen received in the laboratory presented on section a markedly honeycombed appearance. A portion of it was imbedded in celloidin, cut and stained with hæmatoxylin and eosin and eosin-methylene blue. The bacteria appeared to be well preserved but the tissue poorly preserved. This would indicate that considerable post-mortem change hand occurred before the tissue was placed in fixative. The honeycombed appearance of the tissue was apparently due to the destruction of the central lobule and the formation of a large amount of gas by some bacterium which pressed the remaining portion of the tissue to the periphery of the lobule. It was impossible to determine from the specimen whether this was post-mortem or not.

There were apparently two species of bacilli present in the tissue. One, a small bacillus, probably *B. coli communis*, and the other a large spore-bearing, probably a putrefactive bacillus. It was impossible to identify these positively from a simple macroscopic examination.

March 25, 1903, there was received in the laboratory by express, two pigs from the Minnesota State Reformatory, St. Cloud, Minn. These had been sent at the request of Dr. Brimhall and were accompanied by the following data:

"There were 250 hogs in the herd at the Reformatory when the trouble began in January last. 30 showed the disease; some have been condemned for slaughter and killed. The sick animals eat well and die without pain. There are abscesses on the exterior in some cases."

On March 26, 1903, an abscess was opened on the smaller of the two pigs and direct coverslip preparations and cultures were made. The abscess was about one and one-half inches in diameter, filled with cheesy pus.

Direct coverslip preparations and cultures in broth and on serum showed only streptococci present.

These hogs were kept in the laboratory of Animal Research and in a few weeks recovered from the skin abscesses without treatment. They appeared to be in perfect health and were used later for experimental inoculation in connection with the study of swamp fever.

HÆMORRHAGIC SEPTICÆMIA IN CATTLE.

Since August, 1900, this board has had to give attention to numerous outbreaks of hemorrhagic septicæmia in cattle, a disease which, while well known in Europe, Asia, Africa and South America, had prior to the investigations of this board been recognized but once as occurring in North America. The high mortality of the disease in animals of such value as cattle, the rapidity of its spread in herds and a possibility of the infection of animals other than cattle makes the disease one of great importance from a public health standpoint. The subject was deemed of such vital interest that after the publication of a preliminary report in the Journal of Comparative Medicine and Veterinary Archives, December, 1900, this board issued a special bulletin in January, 1901, describing the disease as it had occurred in Minnesota up to that date, and recommending measures for the prevention of its spread. This bulletin was afterward republished in the biennial report for 1899-1900, q. v. This report gives the result of the investigations on the first 64 cases of the disease.

At the meeting of the American Veterinary Medical Association at Minneapolis, Sept. 2, 1902, Dr. S. D. Brimhall read a paper on "Hemorrhagic Septicæmia in Cattle," in which he gave some account of the work done subsequent to Jan. 1, 1901. This paper is published in the proceedings of the Association, page 302, and also in the American Veterinary Review for May, 1903, page 103.

*For a history of the early outbreaks of the disease in Minnesota, for symptoms, pathological and bacteriological findings and early experiments in vaccination, the reader is referred to the above mentioned papers.

In order to give a clear idea of the work done subsequent to that reported above it seems advisable to present a detailed statement of

*In addition to the above mentioned publications, Dr. M. H. Reynolds, formerly a member of this board, published in the American Veterinary Review for December, 1902, and January, 1903, an article describing (1) outbreaks Nos. 4 and 7 which had already been described in the bulletin of this board in January, 1901; (2) an outbreak near St. Michael's Station, Wright county, where on two farms eleven animals were lost. This outbreak was never officially reported to the State Board of Health. (3) Outbreak No. 75, reported in this paper, and (4) several suspected outbreaks near Faribault, Monticello, Belle Plaine and elsewhere. This board received no information concerning any of these suspected outbreaks at the time of their occurrence and consequently was unable to make any investigation of them. The diagnosis of these suspected outbreaks remains in doubt.

the field and laboratory examinations followed by a summary. A reference to the accompanying map showing the location of outbreaks by counties, will be of aid in following the description.

HISTORY OF OUTBREAKS FROM WEEKLY REPORTS OF VETERINARIANS AND FROM LABORATORY RECORDS.

†*Outbreak 9—Clearwater, Wright County.*—Jan. 8, 1901, Dr. Brimhall went to Clearwater, Wright county, to investigate cause of death of four head of cattle belonging to Mr. J. M. These cattle had died a few days before and were badly frozen so that it was impossible to make an autopsy, but from symptoms described by the owner, Dr. Brimhall was satisfied that death was due to hemorrhagic septicæmia.

Blunt, South Dakota.—Aug. 15, 1901, Dr. Brimhall went to Blunt, S. D., to assist Dr. Foster, state veterinarian, in the investigation of supposed anthrax in cattle. In the vicinity of Blunt he visited a number of ranches where many cattle had died, 100 head having been lost on one section. On the farm of Mr. E., who had lost more than 30 head, one case was found which had been sick four weeks. The animal was very thin and the owner was persuaded to permit her to be killed for purposes of autopsy. On opening the animal a few small hemorrhagic areas were found on the spleen, kidney, liver, lung and mediastinal glands. There was also some inflammation of the lungs. Swab cultures were taken from the heart's blood and from a hemorrhagic œdematous knee. No animals recently dead of supposed anthrax were found, but a portion of skin was removed from the carcass of one (Case b) which had been dead six or eight weeks and over which lime had been sprinkled. Cultures and a portion of skin were brought to the laboratory August 20th.

(a) The piece of skin was soaked for 20 minutes in 40 per cent alcohol and thoroughly washed in several changes of the same. It was then removed with sterile forceps and washed through several changes of plain broth, 500 c.c. in all being used. After all precipitation had ceased and all lime had apparently been removed, the tissue was dropped into an Ehrlenmeyer's flask containing 500 c. c. of plain broth and placed in the incubator.

(b) Direct coverslip preparations were made from the various swabs and organs in this case and stained with eosin and methylene

†Outbreaks Nos. 1-8 are described in the bulletin issued January, 1901. See pp. 374-397, 18th Report Minn. State Board of Health.

MAP SHOWING LOCATION OF OUTBREAKS OF HAEMORRHAGIC SEPTICAEMIA IN CATTLE IN MINNESOTA FROM AUGUST, 1900, TO APRIL, 1903.

blue. They showed quite abundant ovoid, belted bacilli morphologically identical with *B. bovisepticus.*

A few sarcinæ were present in the smear preparations from the swab from the knee joint.

Cultures were made from the various swabs and organs received, into the water of condensation of Löffler's blood serum and broth.

A flask of broth inoculated with the bit of skin (specimen A) after 36 hours in the incubator was found to contain two forms of large spore-bearing bacilli. Twenty-four hours later two varieties of colonies appeared. One was a small pasty looking colony which did not liquefy the serum and which was composed of rather large oval shaped spore-bearing bacilli with rounded ends. The other variety of colonies had irregular edges, somewhat rough looking over the surface on both media and were beginning to liquefy the serum. Microscopically, the bacilli from these colonies were B. anthracis. From single colonies sowings were made in and on the various culture media and especially a hanging agar drop culture (by the Wesbrook method). An emulsion was made with broth from the colonies on the surface of one of the agar slant streakings which appeared to be composed mostly of the anthrax-like organism and .05 c.c. of the emulsion inoculated subcutaneously into the groin of guinea pig No. 452, weight 752 grams. Twelve hours later this animal showed marked swelling and œdema without crepitation at the site of inoculation and in the neighboring abdominal region. At autopsy intense œdema of the region noted above was found present. The spleen was much enlarged, black and very soft. From it a pure culture of B. anthracis was obtained as well as numermous smears, which, stained with eosin and methylene blue, showed the presence of no other micro-organisms.

Thirty hours before the death of the guinea pig, i. e., six hours after the preparation of the hanging agar drop culture, a diagnosis was made, with a reasonable degree of certainty, from a microscopic examination of the hanging agar drop culture. The diagnosis in this case was anthrax.

Specimens noted under (*b*). Examination after 36 hours in the incubator of cultures from the heart's blood, spleen, lung and two glands showed pure cultures of *B. bovisepticus.* Cultures from the swabs from the knee joint showed *B. bovisepticus* in great abundance and sarcinæ. Cultures from one of the affected glands, from the kidneys and the liver gave no growth. No other micro-organisms than those noted above, namely *B. bovisepticus* and

sarcinæ, were found in any of the direct coverslip preparations or cultures. The diagnosis in this case was hemorrhagic septicæmia due to *B. bovisepticus,* whilst that noted under (a) was anthrax.

Note.—Though chronic forms of hemorrhagic septicæmia due to bacillus bovisepticus have been noted by other observers, this was the first instance met with in the experience of the Minnesota State Board of Health.

Outbreak 10—*Ham Lake, Anoka County.*—Aug. 21, 1901, Drs. Brimhall and Wilson visited the farms of Mr. N. P. and Mr. A. B. and made a complete post-mortem examination of an animal, the property of Mr. N. P., dead eight hours previousily, and a superficial examination of a steer, the property of Mr. A. B., dead nine hours previously.

The following history of the outbreak was obtained:

About two weeks before, or August 8th, a herd of cattle, ten of which belonged to Mr. P. and four of which belonged to Mr., B. all running together in the same low pasture (wild land) began to show evidence of sickness. Up to August 21st, 12 of the 14 head had died. They all exhibited similar symptoms and died in from one to four days after becoming ill. The animals first began moping, attempting to eat and drink but not successfully. Most of them showed some hemorrhage from the nose and rectum and finally very quickly dropped down and died. The animal first examined, the property of Mr. P., exhibited perfect lesions of hemorrhagic septicæmia, enormous hemorrhages being present under the skin, throughout the muscles and fascia and throughout all of the internal organs.

Cultures were taken from various hemorrhagic areas, heart's blood and spleen. These cultures on examination in the laboratory revealed *B. bovisepticus* in pure culture except in the specimen from the spleen which showed, in addition, a small, motile bacillus irregular in shape, which when isolated proved to be *B. coli communis.* (The animal had been dead eight hours before autopsy was performed and some decomposition had of course, set in).

Owing to lack of time, the animal dead nine hours previously, the property of Mr. B., was examined, but superficially. The skin was removed from the neck where large hemorrhagic areas with œdema were found present. No cultures were taken from this animal.

A diagnosis of hemorrhagic septicæmia was made at the time of making the autopsies.

Outbreak 11—*Bradford, Isanti County.*—Aug. 29, 1901, Dr. Annand and Wilson visited the farm of Mr. J. W. B., Bradford P. O., Minn., and made an autopsy on one animal killed for purpose of autopsy. The history of the outbreak obtained from Mr. B. in brief was as follows:

About three weeks ago this herd of cattle, 12 in all, consisting of cows and young stock which were running in a wild pasture containing a large swamp, began to exhibit symptoms of disease. They moped about, had difficulty in swallowing, bled from the nose and passed bloody fæces and urine. They rapidly grew worse and died in from twenty-four hours to four days. They dropped off, one by one, until six had died and two were ill at the date when the farm was visited. One of the animals, a three-year-old, small black cow which had been ill for three days, was killed by a blow on the forehead and immediately examined. Hemorrhagic areas from pin point to two inches in diameter were found scattered through the subcutis and in the tissue about the udder. Similar hemorrhagic areas, though much larger in extent, were found in the internal organs; the first stomach, pericardium, heart wall and gall bladder being particularly affected. The gall bladder was very much distended and two-thirds of its wall dotted with very black hemorrhagic areas from pin point in size to one-half inch in diameter. This was preserved as a gross specimen by being placed immediately in 10 per cent formaldehyde and five hours later in Kaiserling's fixative.

Cultures were taken from the pericardial fluid, heart's blood and spleen. After 48 hours in the incubator, cultures from the pericardial fluid and heart's blood showed abundant growth and from the spleen scant growth of *B. bovisepticus* apparently in pure culture in all of the tubes except one serum tube inoculated from the pericardial fluid. This contained one yellow colony, which on microscopic examination proved to be sarcinæ, apparently a contamination introduced at the time of making the culture.

Outbreak 12—*Kellogg, Wabasha County.*—Sept. 19, 1901, Drs. Annand and Wilson visited the farm of Mr. T. G., four miles west of Kellogg, Minn., and made an autopsy on the body of a six months old calf, dead twenty-four hours previously.

Two weeks before, or about September 5th, one of Mr. G's. yearling cattle, which was running in a low pasture in the Zumbro river bottom, was noticed sick. The animal was placed in a wagon and hauled to the barnyard where it died some six hours later. It was skinned where it died, then hauled to a field near by and buried.

The other cattle, including the herd in which the first animal became sick and several cows running in another pasture, were all brought into this barnyard at night. About 10 days later, or September 16th, two head of young stock became sick and died within 24 hours. The following day two others became sick. One died the same day, the other lived until the morning of September 18th. This was the animal on which the autopsy was made. The weather was cold, frost having occurred on the night of September 16th, and a cold rain was falling but decomposition was much advanced when the animal was examined. The body was much distended with gas. Some hemorrhagic arears showed about the udder and groin resembling those of "black leg" and contained, along with the other portions of the body, some gas bubbles. Numerous hemorrhagic areas, however, were found about the shoulder, in the heart wall and scattered throughout the internal organs generally, which contained no gas bubbles.

Direct coverslip preparations and cultures were made from the hemorrhagic udder, from the hemorrhagic areas about the shoulder, the heart's blood and spleen. These all presented on microscopic examination an admixture of

(a) A large spore-bearing aerobic bacillus which grew best at room temperature and very slightly at incubator temperature.

(b) *B. coli communis.*

(c) *B. bovisepticus.*

Apparently no other micro-organisms were present in the coverslip preparations or cultures.

Mr. G. was directed to clean up his place with fire and lime and report further cases of the disease if any occurred.

Outbreak 13—*State Experiment Station, Ramsey County.*—On the morning of Oct. 4, 1901, a Jersey heifer, aged two years and three months, in good general condition, at the State Experiment Farm was noted to be bellowing in an unnatural manner and having a wild, unnatural expression of the eyes. The animal was not vicious. Her temperature was a rather low, normal, 99.8. The muscles of the face and neck were almost tetanic. Head drawn back towards shoulders and slightly upward. Neck thus appeared much shortened. Facial muscles were drawn so as to give a peculiarly pointed appearance to the upper lip. In the afternoon of the same day the skin was noted to be no longer sensitive over any portion of the body except ears and nose, where it was slight. Gradually the nervous condition passed away, the bellowing became less violent and less frequent and the heifer became moder-

ately dull. She remained standing all of October 4th and 5th and died late on the evening of the 5th. There had been no apparent pain at any time. The spine had not been sensitive to pressure at any time. The animal was found dead on her back on the morning of October 6th. The head was immediately removed from the body, packed in ice and sent to the laboratory.

October 6th, Dr. M. H. Reynolds made an autopsy on the remainder of the body. He found some hemorrhagic areas within the internal organs, especially marked on auricles of the heart. One large hemorrhagic area was also present over the hock.

In the laboratory on removing the skin from the head, a very large hemorrhagic area was found below and back of the right ear. This was infiltrated with bloody serum and caused external swelling. A bruise apparently from a blow was also present on the pole of the cranium and above the right ear. The vessels of the meninges of the brain were congested and several small, apparently hemorrhagic areas from one-eighth to one-fourth inch in diameter were present on the surface of the brain, particularly on the dorsal surface of the left frontal lobe and the ventral surface of both hemispheres of the cerebrum. One or two minute hemorrhages were also found deeper in the brain substance at the junction of the white and gray matter on section of the cerebral hemisphere.

Direct coverslip preparations from the brain and from the hemorrhagic area back of the ear showed a number of diplococci. Mixed with these in the direct coverslip preparations from the hemorrhagic areas were bacilli which morphologically were indistinguishable from *B. bovisepticus.* Cultures showed the diplococci to be *diplococcus pneumoniæ,* and the bacilli to be *B. bovisepticus.*

Outbreak 14—*Kilkenny, Le Sueur County.*—Nov. 1, 1901, Dr. Annand visited the farm of Mr. D. near Kilkenny, Minn., and held an autopsy on a cow that had died suddenly after having been feeding on standing corn stalks for several days with a number of other cattle. The animal was milked the previous night and was apparently in perfect health, but was found sick in the morning when the owner went out to milk her, and was unable to rise, and died about 11 a. m. A few hemorrhagic lesions were present but not sufficient to warrant a diagnosis of hemorrhagic septicæmia. Portions of spleen, lung and the whole of the heart were brought to the laboratory November 2.

Direct coverslip preparations showed small diplococcoid belted bacilli from the spleen and lung. Broth and serum cultures from

the same source and from the heart's blood, developed similar bacteria. A diagnosis of hemorrhagic septicæmia was made.

Outbreak 15—*Candota Township, Todd County.*—Nov. 20, 1901, Dr. Brimhall went to Sauk Center and visited the farm of Mr. D., who lives six miles from Sauk Center in Candota township, Todd county. Mr. D. had lost five head of cattle within a week out of a herd of eighteen. Two animals in the same herd were suffering with foul in the hoof. Dr. Brimhall made an autopsy on two animals which were dead and unburied. One had been dead 24 hours and the other 72 hours. At autopsy the lesions of hemorrhagic septicæmia were found. Dr. Brimhall instructed the owner as to disinfection, etc. He learned that another farmer southwest of Sauk Center had lost seven head of cattle with probably the same disease. People in the vicinity had considered the trouble due to corn stalk disease.

Owing to the advanced stage of decomposition in which the animals were found no specimens were procured for bacteriological examination.

Outbreaks 16-65—*Worthington, Nobles County.*—Nov. 26, 1901, Drs. Brimhall and Wilson visited the farm of Mr. W., four miles northeast of Worthington, Minn., and made an autopsy on the body of a yearling heifer which had died eight hours previously, after twenty-four hours illness. This was the third animal to die on the place within a week and the outbreak was one of twelve similar ones occurring in the vicinity during the current month.

The animals in all of the herds had been running in standing corn. They sickened and died suddenly. They had been seen by Dr. Gould or his assistant, Mr. Potts, a third year veterinary student. A diagnosis of corn stalk disease had been made from the history on all of the cases, though Dr. Gould, who had seen the demonstration of hemorrhagic septicæmia at the meeting of the State Veterinary Society in January, 1901, said he knew that the disease which he had formerly diagnosed as corn stalk disease, and which was the same as present in these outbreaks, was identical with hemorrhagic septicæmia in history, in symptoms and lesions. Dr. Gould and Mr. Potts had made post-mortem examinations of several of the dead cattle. Dr. Gould reported at this time 15 outbreaks in Nobles county and 35 in Jackson county, with a mortality of about 200 head of cattle in all.

The animal examined by Drs. Brimhall and Wilson was in a good state of preservation. On removing its skin, large hemorrhagic areas were found over the neck, involving the subcutane-

ous tissue and superficial muscles and the pre-scapular and cervical glands. The lungs exhibited collapsed areas, one to three inches in diameter, of typical "swine plague" variety. The heart wall exhibited numerous small, intense, sharply outlined hemorrhagic areas. Hemorrhagic areas were scattered along the alimentary canal, especially in the third stomach. The liver, spleen, kidneys and urine were normal.

Coverslip preparations and broth and serum cultures were collected from the usual sources.

Coverslip preparations from all sources except the pericardium showed *B. bovisepticus.*

Broth and serum cultures, except from the pericardium, showed *B. bovisepticus.* One culture from the spleen showed large bacilli, possibly a contamination. The pericardium showed no growth. *B. bovisepticus* isolated from this case proved of high virulence. Thirteen rabbits when inoculated with minute doses all died in from four to eighteen hours after inoculation.

Outbreak 66—*Dalbo Township, Isanti County.*—Feb. 11, 1902, Dr. Annand went to Dalbo township, Isanti county, to investigate an outbreak of contagious disease in the herd of Mr. R. He was informed that cattle had been dying since November, and that up to the present time Mr. R. had lost forty-one head out of about 275. Some had died suddenly without having appeared ill. Some had lingered for two weeks. The only clinical symptom was weakness. They remained standing until they died, but seemed to be paralyzed behind, so that they were not able to get up, if down. Three cattle were found which were not well. One which seemed worse than the others was killed and post-mortem held. On removing the skin on all four limbs from the knee to the hoof marked hemorrhagic areas were present, also a plastic exudate under the skin on neck and over the pectoral muscles. A front limb was removed from the body, and a plastic exudate below the attachment of the serratus magnus muscle was found. The ribs from the left side were then removed and a plastic exudate on the pleura was found, both pleura and lung being apparently partially organized. The lobe of the left lung was hemorrhagic. One small hemorrhagic area was present in small intestines. A deposit of plastic exudate encircled the kidneys. The spinal cord in the lumbar and cervical region had a plastic exudate encircling it. This probably was the cause of the paralysis. From post-mortem lesions the owner was told that he had an outbreak of hemorrhagic septicæmia. He was advised to clean out all his sheds and disinfect thoroughly, and if

possible to build new yards and feeding racks and put the healthy cattle in the new one, and remove as soon as possible those which should become sick from time to time.

March 18, 1902, Dr. Annand, with Dr. Wilson, again visited the farm of Mr. R. and examined and made an autopsy on the body of a yearling heifer. The animal became sick on March 15th, being down when found. When helped up it was able to walk, but soon fell. It was able to eat and drink and seemed suffering no pain. There was considerable swelling about the ankles. This was still the condition of the animal when seen at 3 p. m., March 18th. The temperature was 100.4. The animal was killed, and a post-mortem made.

There were abrasions about the ankles of both posterior extremities. Hemorrhagic areas on the fetlocks, knees and hocks were found. A few small hemorrhagic areas were present on the neck. The lungs showed one collapsed area about one by two inches in diameter. The fat about the heart was infiltrated with a yellow gelatinous exudate. One small hemorrhagic area was found in the mesentery near the beginning of the rectum. The omentum covering the kidneys contained considerable yellow gelatinous exudate. The other internal organs appeared normal. The spinal canal was completely filled with a yellow gelatinous exudate. No such material was found in the cranial cavity.

Cultures were sown from the usual sources. Portions of lung, heart wall, liver, spleen, the whole of the right kidney and portions of the spinal cord from the lower lumbar, mid-dorsal, and upper cervical regions and of the brain were preserved for histological study.

The cultures from the heart's blood, lung and spinal cord showed *B. bovisepticus* in pure culture. Those from the pericardial fluid showed no growth.

Outbreak 67—*Milaca, Mille Lacs County.*—Feb. 12, 1902, Dr. Annand visited the farm of Mr. W. P., 38 miles north of Milaca, Mille Lacs county, and investigated an outbreak of disease among cattle. Eighteen of the animals had died since January 1st, and one was at the point of death at the time. The herd originally contained 125. Clinical symptoms and post-mortem lesions were almost identical with those in cattle on Mr. R's farm in Dalbo township. The sick animal was killed and an autopsy made. Hemorrhagic areas were found over all the lower portions of the limbs. A yellow plastic exudate was present on the neck under

the shoulder blade, around the kidneys, covering the pleura and surrounding the heart. A number of small hemorrhagic areas were present on small intestines. A yellow plastic exudate surrounded the spinal cord in both lumbar and cervical regions and was continued upward to the base of the brain. A diagnosis of hemorrhagic septicæmia was made. The owner was advised to build a new feeding rack and yard at some distance from the present one, to remove all the apparently perfectly healthy cattle to the new lot, to clean and disinfect one old shed for the sick ones to remain in, and to separate all the sick as soon as they appeared in the healthy herd.

On March 19, 1902, a communication from Mr. P. stated that he had up to that time lost thirty-five head of cattle. April 9th he wrote again saying he had lost forty-five head, and that he proposed trying blackleg vaccine on the remainder. The vaccine was sent him and he used it about April 15th. April 28th he wrote again saying that after vaccinating his cattle twenty more had died, thus making a total of sixty-five head out of his herd of 125.

Outbreak 68—Gordon Township, Todd County.—March 26, 1902, Dr. Brimhall visited the farm of Mr. J. in Gordon township, Todd county. Mr. J. had lost four head of cattle since Christmas and five others were sick. The animals all became ill suddenly. The first symptoms were unsteadiness in walking and turning. This weakness rapidly increased until the posterior extremities were so paralyzed that the animals were unable to stand and had to be helped up. At first they were able to walk after once rising. They grew gradually weaker and emaciated, though the appetite remained good to the last. Two died in less than a week, one lived four weeks and one six. The temperatures of the five sick animals were from one to two degrees below normal.

One, a cow, which had been dead about 36 hours, after six weeks of sickness was examined. Post-mortem changes were quite marked and obscured hemorrhagic lesions which may have been present in the internal organs. Under the skin were found a number of hemorrhagic areas. The significance of these was somewhat masked by the fact that considerable bruising had occurred during the animal's long illness. A portion of the spinal column containing spinal cord was brought to the laboratory March 27th. Direct coverslip preparations from the meninges of the cord showed many bacteria, including small belted ovoid bacilli, long colon-like bacilli and large spore-bearing bacilli.

Cultures on serum and in broth gave an abundant growth from

which were isolated *B. bovisepticus*, *B. coli communis* and a large spore-bearing putrefactive bacillus.

Outbreak 69—Osakis, Douglas County.—March 26, 1902, while Dr. Brimhall was engaged in investigating the outbreak of hemorrhagic septicæmia noted above in Gordon township, Todd county, a liveryman at Osakis informed him that his (the liveryman's) cow a few months before had gotten sick, first showing a swelling on the brisket then on the fore legs about the ankle joints, growing rapidly emaciated and dying after about three months' illness. On skinning her he had found many bloody spots under the skin.

On considering this case in relation to the outbreak at Mr. J's. above noted, Dr. Brimhall was of the opinion that the case might have been one of hemorrhagic septicæmia. While nothing positive can be asserted as to the diagnosis, the case seems to be worthy of record.

Outbreak 70—Brooten, Stearns County.—On the 24th of April, 1902, Dr. Brimhall visited the farm of Mr. O. S., four miles southwest from Brooten, Minn. Mr. S. originally had 12 head of cattle. Two died about a week ago and four were sick at the time of Dr. Brimhall's visit. Three of them were unable to get up. The temperatures of these animals were taken. The two which were killed later had a temperature of 98½°. A cow that was still able to get up had a temperature of 102°, and a calf which was unable to get up, but frequently endeavored to do so, had a temperature of 104°. The owner said they did not eat well and some of them he had noticed being lame. The cow that was down was breathing heavily; had been able to get up and down until that morning. There was some discharge from her nose.

The cow and steer calf were killed and autopsies made at once.

The cow showed one small hemorrhagic area on the inner side of the hock joint, but no others were found on the side from which the skin was removed excepting a large area on the neck, but this was caused from the operation of bleeding which was done a few days previously. The internal organs showed no change except the spleen, which was much enlarged; the pulp was very dark and soft and showed a few small, hemorrhagic areas. After opening the abdomen in a short time the spleen shrank to nearly half its original size. The spinal cord showed marked exudate and considerable fluid ran out as the spinal column was sawn into. After burning off the spleen, swabs and cultures were taken and from the spinal canal without burning. Broth and serum were inoculated at

once. A portion of the spleen was cut out and brought to the laboratory in a sterile bottle.

The steer calf showed no hemorrhagic lesions under the skin except in the flank and groin. These were very marked on both hind legs. The internal organs showed no change excepting the lungs which were congested and showed a few small hemorrhagic areas. The spinal cord showed a marked exudate with bloody serum. Cultures were taken from the spinal cord and from the hemorrhagic areas and inoculated into broth and serum. In the laboratory, cultures on various media showed spore-bearing bacilli, small motile bacilli, staphylocci and a few small diplococcoid non-motile bacilli morphologically *B. bovisepticus*. The latter was not isolated in pure culture owing to the enormous overgrowth of the other organisms.

Outbreak 71—Little Falls, Morrison County.—April 25, 1902, Dr. Annand visited the farm of R. Bros. near Little Falls, Minn., to test the herd of cattle for tuberculosis. Three head of cattle had died out of a herd of about forty head. The sick ones had recently been brought from Iowa. On arriving at the farm one animal was found sick and unable to rise. Being suspicious that the cause of the disease was not due to tuberculosis Dr. Annand killed this animal and made a post-mortem examination. Marked lesions of hæmorrhagic septicæmia were abundant. Specimens were brought to the laboratory and *B. bovisepticus* isolated.

Outbreak 72—Kimberly, Aitkin County.—Early in April, 1902, Dr. J. G. Harris of Duluth called at the office of this board and in conversation with Dr. Brimhall described an outbreak of the disease among cattle on the farm of McR. Bros., near Kimberly, Aitkin county. From Dr. Harris' description of the onset, symptoms, etc., of the animals there seemed little doubt that they were suffering from hæmorrhagic septicæmia, some of them with the chronic type. A request was made for specimens to be sent to the laboratory.

On May 2, 1902, there was received in the laboratory two portions of spinal column containing spinal cord with a letter from Dr. Harris saying: "Mr. McR. of McR. Bros. has just telephoned me that he is sending you by express to-day portions of spinal column from two animals from his place. The larger piece (from the lumbar region, I believe) is from a young animal that had just died of the disease. The smaller piece is from an animal that was killed after having been sick some time. About sixty head of cattle have died on this place during the spring. In conversation with Drs.

Brimhall and Reynolds, some time ago, we concluded that the disease was hemorrhagic septicæmia."

The specimens when received in the laboratory were too much decomposed to permit the determination of any pathological lesion which may have been present. Direct coverslip preparations from the pia of the cord (central portion of the specimen) showed colon like bacilli. Cultures in broth on serum and agar showed only B. coli communis.

Granting that the disease was correctly diagnosed as hemorrhagic septicæmia, which seemed probable from Dr. Harris' description, either no lesions containing the specific bacteria existed in the spinal cord, or they were destroyed by the processes of decomposition, or masked by *B. coli communis.*

Outbreak 73—Huntersville Township, Wadena County.—May 21, 1902, Dr. Annand visited the farm of Mr. G., Huntersville township, Wadena county (near Park Rapids), and investigated an outbreak of infectious disease among Mr. G's. cattle. Mr. G. had originally about 25 cattle in his herd. Of these he had lost nine head. Six others had been sick. Five of these had recovered after three to six weeks illness. One, a cow, was still sick, but Mr. G. thought at the time that she was improving. The symptoms were those of a chronic paralytic type, such as described above. Several of the cows had, after becoming unable to rise, aborted. The beginning of their recovery seemed to date from the abortion. No material for autopsy was obtained, but from the history and the appearance of the one sick cow, a diagnosis of chronic hemorrhagic septicæmia was made.

Outbreak 74—Huntersville Township, Wadena County.—May 22, 1902, Dr. Annand visited the farm of Mr. H. H. in Huntersville township, Wadena county. Mr. H. had lost 12 head of cattle. Four others had been sick but recovered. One, a calf, was sick at the time of Dr. Annand's visit. The calf had been in a worse condition three days before, having been unable to rise, though he was able to get up of his own accord just before being killed. The animal was slaughtered by Dr. Annand and an autopsy made.

On skinning, one small hemorrhagic area was found on the left hind foot in the region of the inner cannon bone. On opening the carcass a yellow plastic exudate surrounded the kidneys. A small amount of the same exudate was present in the pleural cavity. The two anterior lobes of both lungs were much inflamed, being hemorrhagic in appearance and with some pus (?) formation. On sec-

tion both kidneys showed a plastic exudate in the pelvis, and some cortical congestion. The spinal cord in the sacro-lumbar region and about the medulla was surrounded by a yellow plastic exudate. Specimens from the lung, heart, liver, kidney and spinal cord were collected and taken to the laboratory.

In the laboratory the cultures above mentioned showed from the lung, heart, liver and spinal cord *B. bovisepticus*. From the kidney, in addition to *B. bovisepticus* was found *B. coli communis*.

Outbreak 75—State Experiment Station, Ramsey County.—On Saturday, June 7, 1902, it was first noticed that eight head of cows in the State Experiment Station herd gave very little milk. On Sunday, the 8th, they were noticed depressed; would not eat, but some of them were reported as appearing much better, and it was thought they would recover. Later in the day they began showing meningeal symptoms, such as turning in a circle, pulling backwards, butting their heads against objects and appearing generally wild. A twitching of the muscles was also noticed and autopsies were made on these two animals and one other noted above by Drs. Brimhall, Reynolds and Beckman.

Six of the eight head which were originally taken sick died during Sunday night and early Monday morning. The other two were found sick on Monday morning and one of them would not get up at the time of observation by Dr. Reynolds. The one which would get up was not noticed at first as being excitable and appeared quite normal; temperature 100.1°. The other one could not be made to rise and she had distinct twisting of the neck due to contraction of the muscles. The eyes had a vacant appearance and she was apparently totally blind. Her temperature was not quite 100°. Both of these animals became worse and died that night. On June ninth autopsies were made on these two animals and one other noted above by Drs. Brimhall, Reynolds and Beckman.

These animals had been dead 15 to 18 hours and as the weather was quite hot, the post-mortem changes were rapid. They had been skinned, some of them for a considerable length of time, and the surface of the carcass having become dried, the superficial lesions were obscured. Some areas of hemorrhage had been noticed, but the fact that the cattle had been so violent in the stable before dying, made their significance somewhat doubtful since the lesions had not been observed in their fresh state.

Internal lesions. The lungs of all of them showed distinct congestion in the anterior lobes especially surrounding the heart and blood vessels. In nearly all of them there was a slight, reddish

exudate bound to the costal pleura. There were no characteristic hemorrhagic areas of any considerable size observed in the internal organs. The meninges of the brain and cord showed marked congestion and surrounding the cord was considerable inflammatory exudate.

Cultures were taken in each case from the meninges, pharyngeal glands, lung, heart's blood, liver and spleen. The animals had been dead so long, and the weather being warm, bacterial invasion had been rapid.

From cow No. 6, *B. bovisepticus* was obtained from the meninges and lung, mixed with other organisms, namely, colon and other large bacilli. From cow No. 7, *B. bovisepticus* was obtained in pure culture from the pharyngeal gland and mixed with other organisms from the lung. From cow No. 8, no pathogenic bacteria were found, all the cultures containing *B. coli communis* and large, liquefying organisms.

On June 13, 1902, rabbit No. 569 was inoculated intravenously with a 24-hour broth and serum emulsion of *B. bovisepticus* obtained from the meninges of cow No. 6. This rabbit died June 16, 1902. At autopsy, a large, hemorrhagic area was found in the subcutaneous tissue of the chest. The peritoneal cavity contained a large amount of bloody exudate and small hemorrhages were found in the intestines. *B. bovisepticus* was obtained in pure culture from the heart's blood.

June 13, 1902, rabbit No. 570 was inoculated, intravenously, with a 48-hour broth and serum culture of *B. bovisepticus* obtained from the pharyngeal gland of cow No. 7. This rabbit showed no symptoms.

The ninth animal was taken sick on June 11th, and died the same night. She was not noticed excitable; her temperature was not observed above normal, but before death she evidently moved some distance from the place where she was last observed.

Th last animal was observed in a better condition at autopsy June 12th, and in removing both front legs characteristic hemorrhagic areas were found under the scapula. Small hemorrhagic areas were found on the pericardium, the parietal pleura and on the heart itself. The lungs had the same congested appearance as noticed in previous cases with a few small, characteristic hemorrhagic areas. The cord, especially in the region of the medulla, was surrounded by a distinct hemorrhage with a bloody exudate and the membranes of the cord were distended by a quantity of clear fluid. The brain and coverings were free from congestion. This animal

had also been skinned. The carcass having become dried, the superficial lesions could not be observed.

Cultures were taken from the meninges, pharyngeal glands, glands of the shoulder, heart's blood, lung, liver, spleen and amniotic fluid. *B. bovisepticus* was obtained in pure culture from the liver and spleen. All the other cultures were overgrown with colon and liquefying organisms.

On June 17, 1902, rabbit No. 573 was inoculated intravenously, with a 24-hour broth and serum culture of *B. bovisepticus* obtained from the spleen. This rabbit has shown no symptoms. On the same date, rabbit No. 574 was inoculated with a 24-hour broth and serum culture of *B. bovisepticus* obtained from the liver of this cow. This rabbit died June 22d. At autopsy, minute hemorrhages were found over the auricles of the heart. No other gross lesions were observed.

It will thus be seen that although these animals presented characteristic symptoms of cerebo-spinal meningitis such as are caused by *diplococcus pneumoniæ*, this organism was not obtained in any of the four cases at autopsy, but instead the autopsy findings were those of hemorrhagic septicæmia, and bacillus bovisepticus was obtained from three of the four animals examined and shown to be virulent. The failure to obtain *B. bovisepticus* from one of the cows was probably owing to the very great mixture of other organisms which developed post-mortem. There can be no question but that the disease was hemorrhagic septicæmia affecting primarily the central nervous system; in other words, a primary cerebro-spinal meningitis due to *B. bovisepticus.*

Outbreak 76—Perham, Otter Tail County.—July 23, 1902, Dr. Edward C. Schoonmaker, health officer of Perham, reported to Dr. Brimhall that there had been 20 head of cattle lost in that village during the winter, and that Dr. Judd, veterinarian, after consulting Dr. Annand, had diagnosed the cause of the deaths to be due to chronic hæmorrhagic septicæmia. Dr. Brimhall had further correspondence with Dr. Judd and from the history and symptoms as described by him Dr. Brimhall confirmed the diagnosis.

Outbreak 77—Sauk Center Township, Stearns Co.—July 30, 1902, Dr. Annand investigated an outbreak of cattle disease on the farm of Mr. W. H. P. in Sauk Center Township, Stearns county. Three animals presented swellings on different parts of the body. One heifer had an enlargement in the submaxillary space which had erupted and at the time was nearly well. One steer had had an enlargement in the region of the right stifle. This

had also opened and discharged. Another steer had an enlargement close to the posterior angle of the lower jaw on the right side of the head, and a row of enlargements or bunches upon the external surface of the right hind leg from the hock to the hoof. These latter were opened by Dr. Annand and a peculiar semi-fluid pus (?), having a consistency of melted glue, was found. A small amount of this material was collected in a sterilized bottle and sent to the laboratory.

The material above noted showed in direct coverslips a very few small diplococcoid belted bacilli. Cultures in broth and on serum gave *B. bovisepticus* in abundance in the mixture with a few large spore-bearing bacilli with rounded ends (contamination from hair?).

These cases are of peculiar interest in showing the chronic form of hemorrhagic septicæmia with pus formation which has been noted by other observers, but which, prior to this time, had not been observed in Minnesota except when associated with other symptoms, either in the same animal or in other animals in the same outbreak.

Outbreak 78—Burnhamville Township, Todd County.—Sept. 30, 1902, Dr. Annand visited the farm of Mr. C. Z., Burnhamville township, Todd county (14 miles east of Long Prairie), to investigate a report of supposed tuberculosis.

During the winter of 1901 and 1902 some of Mr. Z's. cattle had been ailing, that is, were coughing and did not put on flesh rapidly. All appeared, however, to make complete recovery during the spring. About three weeks ago, one cow was found dead in the pasture, four to six hours after she had been observed eating, apparently in perfect health. Another was found dead in the barn on the following morning though she had given the ordinary amount of milk on the previous evening. A third after ailing about two weeks was killed. A fourth which had been sick two or three weeks was destroyed for autopsy September 30th, at 4 p. m. by Dr. Annand. The animal which had been in good health up to two weeks ago and in good order was now markedly emaciated and coughed frequently. On post-mortem examination the only lesions present were as follows:

Marked gelatinous exudate in the intercostal muscles on both sides.

Posterior lobes of both lungs of typical "swine plague" variety.

Small hemorrhagic areas were scattered throughout the other lobes also.

Minute petechiæ were present on the pericardium.

About two quarts of fluid was in the peritoneal cavity.

The spleen was of the dry variety noted in some previous outbreaks.

Immediately before death this animal's temperature was 103.6 and pulse rate 82.

On receipt in the laboratory direct coverslip preparations and cultures were made from each of the specimens. After 24 hours incubation the broth cultures showed the following:

Heart's blood. Diploccocci and small diplococcoid, non-motile banded Gram-minus bacilli (probably B. *bovisepticus*).

Heart's wall. *B. coli communis* (?), long slender bacilli, non-motile and diplococci.

Lung. Diplococci, *B. coli communis,* large spore-bearing bacilli and a very few resembling *B. hemorrhagic septicæmia.*

Spleen. *B. coli communis,* large spore-bearing bacilli, small oval spore-bearing bacilli and a few diplococci.

Original broth cultures were diluted into second broths and from these streak cultures were made on agar and serum. After 24 hours incubation 41 single colonies were picked from the agar and serum from various sources. After 24 hours incubation these were examined in stained and hanging drop preparations and certain of them sown on various differentiating media.

There was thus obtained:

Heart's blood. *B. bovisepticus* and *diplococcus pneumoniæ.*

Heart's wall. *Diplococcus pneumoniæ, B. coli communis* and a small unidentified bacillus.

Lung. *B. coli communis, diplococcus pneumoniæ* and an unidentified spore-bearing bacillus.

Spleen. *B. coli communis* and large and small spore-bearing bacilli.

Summary. The specimens had been much contaminated when received in the laboratory. Probably the only bacteria of pathological significance was *B. bovisepticus* and perhaps *diplococcus pneumoniæ.*

Outbreak 79.—Jasper, Pipestone County.—Oct. 28, 1902, Dr. Brimhall visited the farm of Mr. A. M., near Jasper, Pipestone county. Mr. M. had lost 11 head of cattle during the previous week. He thought the cause of death was due to sudden change of feed to soft corn and barley. His herd had originally consisted of 37 feeding steers and six calves. They had been taken out of rape pasture October 25th, and put on soft snap corn with ground barley in limited quantity. On the morning of the 26th, all of the

animals were noticed to be "dumpish" and some appeared to be sick. On the 27th five were dead. The rest showed distinct symptoms of sickness, being stiff, lying down and breathing hard. All but one had severe diarrhoea. On the 28th, five cattle and one calf were found dead. The owner said that all of them bloated severely though this was not found to be true by Dr. Brimhall.

An autopsy was made on one dead about 48 hours. There were no well marked lesions, but the few present were of a distinctly hemorrhagic character. The animal which had been dead about 24 hours showed distinct hemorrhagic enteritis. The owner was told that the trouble was possibly hemorrhagic septicæmia and that the infection if any might have been obtained from the field where the snap corn was gathered. He was advised to feed no more of it.

Portions of lung and spleen from these two autopsies were brought to the laboratory Oct. 30, 1902. They were in an advanced state of decomposition and no bacteria resembling B. bovisepticus were obtained.

This outbreak is here mentioned to show the difficulty of diagnosis from history and symptoms and autopsy observations or bacteriological examination from decomposed material after decomposition has set in.

Outbreak 80—*Altona Township, Pipestone County.*—Nov. 23, 1902, Dr. Annand visited the farm of Mr. A. T., Altona Township, Pipestone county, near Verdi, Minn. Mr. T. had lost seven head of cattle in two weeks previous and two others were sick at the time of Dr. Annand's visit. One calf had died about six hours before Dr. Annand's arrival, after an illness of about 16 hours. A post-mortem examination was made at once. A large hemorrhage area was present on left side of the neck along the cervical muscles. Another large hemorrhagic area was present on the right side over the ribs. The third was present on the inner aspect of the left hind limb. Numerous smaller areas were present on the extremities above the hock joints. On the articular surface of the metatarsals and metacarpals small hemorrhagic areas were also present. The lung showed hemorrhagic lesions of the swine plague type. The small intestines were much congested. The animal had had a slight bloody discharge from the nose and the fæcal matter was streaked with blood previous to death. Mr. T's boys, who had skinned the other six head of cattle, stated that there were more or less bruises on the body similar to those found in this animal.

Cultures were made from heart, lung and liver in broth and on serum. After 24 hours in the incubator those from the heart and lung showed bacteria which on further culture proved to be B. bovisepticus. There was also present on all of the organs B. coli communis. (This latter may have been a contamination due to the method of collection and shipment of the specimen.)

Outbreak 81—*Perham Township, Otter Tail County.*—Dec. 23, 1902, Dr. F. E. Judd of Perham, Minn., reported to the veterinary department of this board that "on the 18th of December Mr. S. H. of Perham Township, Otter Tail county, lost a calf about six months old which had been sick only ten hours. When first noticed to be sick it had ceased eating and began to stagger about. In a short time it lay down and refused to get up. There was excessive diarrhoea but the animal did not seem to be in much pain. After it died and while removing the hide they noticed what they called 'blood clots' in the connective tissue along the side of the neck. They said these clots were about one inch in diameter and the tongue was covered with dark 'pustules' which contained blood.

"On December 21st they called Dr. Judd to the farm to see a three-year-old heifer which had refused its food and was moaning, and when moving about showed a staggering gait. The animal had a bad diarrhoea and when examined by Dr. Judd was lying down and refused to get up. After some excitement, however, she did get up, but seemed to be very weak, though in little pain. Her temperature was 102.5. The discharge from the bowels was black and 'muco-tarry' in appearance. There was no positive swelling on her. She died about an hour after. Autopsy showed hemorrhagic spots in the connective tissue just under the skin, varying in size from one-eighth to two inches in diameter. There were larger spots, also, along the cervical region. The peritoneal fluid was slightly yellowish. The peritoneum and pleura were more or less covered with hemorrhagic spots. The lungs, liver and spleen were also somewhat involved. The heart was slightly filled with clotted blood. A diagnosis of hemorrhagic septicæmia was made.

"December 22d another calf began developing the same symptoms and died in 24 hours."

Mr. H. had 10 head of cattle in this herd; all in good flesh; He had been feeding slough hay, corn, oats, straw and some bran. He had not added any cattle to his herd in the preceding six months. He was advised to isolate the well cattle from the sick

and destroy all bedding and litter in the stable and to use plenty of antiseptics and disinfectants.

Outbreak 82—Lake Park Township, Becker County.—Dec. 27, 1902, Dr. A. Youngberg of Detroit, Minn., visited the farm of Mr. E. G. M., near Lake Park, Minn., and investigated an outbreak of cattle disease. Mr. M. had lost five head of cattle in two weeks immediately preceding Dr. Youngberg's visit. One had died shortly before. An autopsy was made and portions of lung, pleura, peritoneum and brain, packed together in an unsterilized fruit jar and sent to the laboratory. From the history and symptoms and post-mortem lesions Dr. Youngberger diagnosed the disease as hæmorrhagic septicæmia.

The specimens when received in the laboratory were much decomposed. Coverslip preparations and cultures showed only B. coli communis and a large square ended (putrefactive?) bacillus.

Outbreak 83—West Concord, Dodge County.—Jan. 9, 1903, Dr. Annand visited the farm of Mr. H., six miles west of West Concord. Mr. H. had lost two head of cattle in October, 1902, and had been losing them at irregular intervals since. He lost in all seven head. All were young stock—calves to yearlings. A calf a few months old was killed and an autopsy made at once. Many large hæmorrhagic areas were found on the extremities and small ones in the lungs and intestines. A diagnosis of hæmorrhagic septicæmia was made.

Outbreak 84—St. Peter, Nicollet County.—Feb. 6, 1903, there was received in the laboratory, through Dr. Brimhall, specimens of organs from a steer which had been killed by Dr. Lambert of St. Peter, Minn., for purpose of autopsy, on Feb. 3, 1903.

The animal was one of a herd of 35, the property of Mr. O. Three others had died prior to February 3d, after exhibiting symptoms of rapid, labored breathing, temperature 103° to 104.5°; loss of appetite, mucous or bloody discharge from the bowels and great icthyosis of skin.

Specimens consisted of portions of lung, heart, spleen and liver. Though the weather was cold they were not frozen and had begun to decompose.

Cultures were made in broth and on serum from each of the four sources. After incubation bacteria as follows were found:

Lung. *B. bovisepticus*, diplococci.

Spleen. *B. bovisepticus*, large spore-bearing bacilli, probably putrefactive.

Liver. Large spore-bearing bacilli, probably putrefactive.

All organs. *B. coli communis.*

The only organism of pathological significance here found was *B.bovisepticus,* and a diagnosis of *hemorrhagic septicæmia* was given.

Feb. 12, 1903, there was received in the laboratory from Dr. J. G. Annand, organs from a steer which he had killed on the previous day for purpose of autopsy. The animal had been the property of Mr. O. near St. Peter, Minn., and one of the same herd as that from which the animal in the case reported by Dr. Lambert came.

Specimens were cold but not frozen when received in the laboratory.

Direct coverslip preparations and cultures were made from the spinal cord, lung, spleen and liver.

The *bacillus of hemorrhagic septicæmia* was found in preparations from lung, spleen and spinal cord.

B. coli communis and a large spore-bearing bacillus from lung, spleen and liver.

Mr. H. had 10 head of cattle in this herd; all in good flesh.

Outbreak 85—*Elmore, Faribault County.*—Feb. 18, 1903, Dr. Annand visited the farm of Mr. K. near Elmore, Minn., to investigate an outbreak of disease among a herd of 16 cattle. All the animals, eight, which had been sick had been dead some time at the time of Dr. Annand's visit and no post-mortem examination could be obtained. From the history and symptoms described, Dr. Annand felt positive that hæmorrhagic septicæmia was the cause of the loss.

Outbreak 86—*Ripley Township, Dodge County.*—Feb. 23, 1903, Dr. Annand visited the farm of Mr. S., then operated by Mr. M., in Ripley Township, Dodge county, near Dodge Center, and investigated an outbreak of disease among cattle and sheep. The herd of cattle consisted originally of 103 head, of which more than 50 had died since the middle of January. The first to die were two old cows. The owner had skinned two or three of the animals and found skin lesions, such as Dr. Annand afterward found in autopsy. (See below.) One steer had taken sick February 21st, and at the time of Dr. Annand's visit was down and almost dead. The animal was killed and an autopsy made at once. Numerous large hæmorrhagic lesions were present about the neck, shoulder, fetlock and hock; smaller ones were scattered over the body. The lesions on the internal organs were not large nor well marked. Portions of the lung, heart, spleen, liver and kidney were taken to the laboratory.

Direct coverslip preparations and cultures in broth and on serum were made from each organ.

Direct coverslip preparations from the spleen and liver stained with eosin and methylene blue showed each a few diplococcoid belted bacilli. Similar preparations from the lung, heart and kidney showed no organisms.

Cultures, after 24 hours in the incubator, showed no growth from heart's blood or kidney. From the liver and spleen a pure culture of *B. bovisepticus* was obtained. From the lung *B. bovisepticus* was isolated from a mixture of diplococci and a large liquefying mould-like organism, probably a contamination.

Mr. M. had also lost 16 head of sheep since the middle of January, and apparently from the same disease as that causing the death of cattle. Post-mortem examination was held on one ewe, and hemorrhagic lesions similar to those found in the steer were present, though not well marked. Portions of lung, heart, spleen, liver and kidney were brought to the laboratory. Direct coverslip preparations and cultures in broth and on serum were made from each of the organs. Direct coverslip preparations stained with eosin and methylene blue showed from the spleen a very few small diplococcoid belted bacilli. Those from the other organs showed no bacteria. After 24 hours in the incubator the cultures from the spleen and liver showed small diplococcoid bacilli which were proven on subsequent cultures to be *B. hæmorrhagica septicæmiae.* All other cultures remained sterile after seven days in the incubator.

Outbreak 87—*Wyanett Township, Isanti County.*—Feb. 25, 1903, Dr. Annand visited the farm of Mr. W., in Wyanett Township, Isanti county, to investigate a case of supposed tuberculosis. He found, however, that it was a case which from history and symptoms was undoubtedly hæmorrhagic septicæmia.

Outbreak 88—*Walcott Township, Rice County.*—March 11, 1903, Dr. Annand visited the farm of Mr. C., Walcott Township, Rice county, near Faribault, to investigate an outbreak of disease in a herd of cattle. Mr. C. had lost six out of a herd of 40 in two or three weeks just prior to Dr. Annand's visit. One which had recently died was examined post-mortem. Typical lesions of hæmorrhagic septicæmia were present. A change of yard and disinfection of the barn was advised.

Outbreak 89—*Twin Lakes Township, Freeborn County.*—March 12, 1903, Dr. Annand visited the farm of Mr. E. A. O., Twin Lakes Township, Freeborn county, near Albert Lea. Mr. O. reported the

recent loss of eight head of cattle out of his herd of 60. A post-mortem examination was made on a calf which had died the previous night. Typical lesions of hemorrhagic septicæmia were found. A change of yard and disinfection of barns were advised.

Outbreak 90—*Wadena, Wadena County.*—March 26, 1903, Dr. Annand visited the farm of Mr. F., near Wadena, in Wadena county, to investigate the cause of some obscure disease in cattle. Mr. F. had had four sick cattle which he had destroyed when they were almost dead. This was several days before Dr. Annand's visit and no post-mortem could be obtained. There were no marked symptoms in any of the 40 head of cattle still remaining alive. From the history of the four animals which had been killed Dr. Annand was satisfied that they had been suffering from hemorrhagic septicæmia.

Outbreak 91—*White Earth, Becker County.*—March 30, 1903, Dr. A. Youngberg of Detroit, Minn., visited the White Earth Indian Reservation and examined and made an autopsy on two cattle (the property of the government). Several others had died just prior to Dr. Youngberg's visit. These two were quite sick and were killed for an autopsy. Hemorrhagic lesions were found subcutaneously and along the internal organs. Portions of heart wall and brain were placed in a small bottle and sent to the laboratory. These specimens were four days in transit and when received in the laboratory were covered with a thick, bloody fluid. No growth could be obtained from either the tissues or the fluid though large spore-bearing bacteria were present in direct coverslip preparations. On inquiry it was found that the bottle contained some whisky when the specimens were placed in it. While the results of the bacterial examination were thus negatived, the clinical and post-mortem observations were sufficiently clear to warrant a diagnosis of hemorrhagic septicæmia.

TABLE SHOWING OUTBREAKS OF HÆMORRHAGIC SEPTICÆMIA IN CATTLE IN MINNESOTA AUGUST, 1900, TO APRIL, 1903.

No. of Outbreak.	Investigation Began.	County.	Township.	No. of Cattle in Herd.	No. of Cattle Sick.	No. of Cattle Dead.
*1	August 18, 1900	Washington	Woodbury	26	15	15
*2	August 21, 1900	Anoka	Columbus	16	6	6
*3	Sept. 25, 1900	Todd	Eagle Valley	25	18	18
*4	October 31, 1900	Chisago	Branch	13	4	4
*5	Nov. 21, 1900	Redwood	Vesta	30	3	3
*6	Nov. 21, 1900	Redwood	Vesta	11	4	4
*7	Nov. 29, 1900	Wright	Cokato	13	8	8
*8	Dec. 18, 1900	Wabasha	Greenfield	26	6	6
9	January 8, 1901	Wright	Clearwater	18 ?	4	4
10	August 21, 1901	Anoka	Ham Lake	14	12	12
11	August 29, 1901	Isanti	Bradford	12	8	8
12	Sept. 19, 1901	Wabasha	Kellogg	20 ?	5	5
13	Oct. 4, 1901	Ramsey	State Experim't Sta.	35 ?	1	1
14	Nov. 1, 1901	Le Sueur	Kilkenny	15 ?	1	1
15	Nov. 20, 1901	Todd	Kandota	18	5	5
16-65	Nov. 26, 1901	Nobles / Jackson	Worthington	1,000 ?	200 ?	200?
66	Feb. 11, 1902	Isanti	Dalbo	275	42	42
67	Feb. 12, 1902	Mille Lacs	Milaca	125	65	65
68	March 26, 1902	Todd	Gordon,	16 ?	9	5
69	March 26, 1902	Douglas	Osakis	1	1	1
70	April 24, 1902	Stearns	Brooten	12	6	6
71	April 25, 1902	Morrison	Little Falls	40 ?	4	4
72	May 2, 1902	Aitkin	Kimberley	425	60	60
73	May 21, 1902	Wadena	Huntersville	25	15	9
74	May 22, 1902	Wadena	Huntersville	40 ?	17	13
75	June 7, 1902	Ramsey	State Experim't Sta.	35 ?	9	9
76	July 23, 1902	Otter Tail	Perham	35 ?	20	20
77	July 30, 1902	Stearns	Sauk Center	25 ?	3	0
78	Sept. 30, 1902	Todd	Burnhamville	40 ?	20	6
79	Oct. 28, 1902	Pipestone	Jasper	43	11	11
80	Nov. 23, 1902	Pipestone	Altona	40 ?	9	8
81	Dec. 23, 1902	Otter Tail	Perham	10	3	3
82	Dec. 27, 1902	Becker	Lake Park	10 ?	5	5
83	January 9, 1903	Dodge	West Concord	22	7	7
84	Feb. 6, 1903	Nicollet	St. Peter	33	5	5
85	Feb. 18, 1903	Faribault	Elmore	16	8	8
86	Feb. 23, 1903	Dodge	Ripley	103	52	52
87	Feb. 25, 1903	Isanti	Wyanett	4	1	1
88	March 11, 1903	Rice	Walcott	40	6	6
89	March 12, 1903	Freeborn	Twin Lakes	60	8	8
90	March 26, 1903	Wadena	Wadena	44	4	4
91	March 30, 1903	Becker	White Earth	40 ?	6	6
	Total			2,851	696	664

* These 8 outbreaks were reported in the bulletin issued by this Board, January, 1901, and appear in the eighteenth report of this Board, pages 322-433.

? These figures are as nearly correct as possible, but exact information was not obtainable.

Summary. 1. It will be seen from the preceding detailed statement and the above map and table that from August, 1900, until April, 1903, this board has investigated in the state 91 outbreaks of hæmorrhagic septicæmia in cattle. These have been distributed in 26 counties. The total number of animals in the infected herds was about 2,850. Of these 696 became sick, of which 32 recovered and 664 died, making the mortality slightly over 95 per cent.

In addition to these outbreaks, the board has assisted the authorities of South Dakota in the investigation of supposed anthrax in cattle, some of which proved to be hemorrhagic septicæmia and some anthrax.

2. In addition to the symptoms described in the previous bulletin of the board, namely, loss of appetite, fever, stiffness, swelling of the legs and throat and a black, tarry or bloody discharge from the bowels, the symptoms of meningeal involvement as exhibited in Outbreaks Nos. 66, 67, 68, 70 and 75 are of particular interest. This type of the disease has been frequently described by other observers, but had not been met with in Minnesota up to the time of the issuing of the board's first bulletin on the subject. The local manifestation of the disease as exhibited in Outbreak No. 77, although previously described by other observers, has been met with but once in Minnesota.

3. The chief lesions discovered at autopsy have been ecchymoses, small and large hemorrhagic areas in the subcutaneous tissue, muscles, lymph glands and throughout the internal organs. The cervical lymph glands, heart muscle and alimentary canal were most affected. The spleen was rarely enlarged or darkened (except after the onset of decomposition). In those cases which exhibited meningeal symptoms there was a distinct meningitis with, in some cases, a plastic exudate almost filling the spinal canal and involving also the base of the brain.

4. Material from 27 outbreaks was investigated bacteriologically. Specimens were received in all from 47 animals. In 42 of these bacillus bovisepticus was insolated in pure culture. The specimens from the remaining 5 cases in which *B. bovisepticus* was not found were all in a very advanced state of decomposition when received in the laboratory. It is worthy of note that in all cases in which the cultures were sown immediately after death *B. bovisepticus* was obtained unmixed with any other organisms. Where decomposition was more or less advanced there were usually present putrefactive organisms.

The virulence of *B. bovisepticus* isolated from nearly all of the cases was tested on rabbits and from several on cattle. While there was considerable variation, most of the strains when recently isolated exhibited a high degree of virulence. It is not surprising that an organism which is so widely distributed and that affects such a great variety of animals as does the bacillus of hemorrhagic septicæmia, should exhibit a great variation in virulence nor that it should be found, as it has been by Smith and Moore,* finding lodgment in the upper air passages of animals and causing no symptoms. It will not do, however, to assume that since some members of the hemorrhagic septicæmia group of bacteria are occasionally found producing no symptoms though present in the air passages of cattle, that they are incapable of producing pneumonia when the normal resisting power of the animal is by any means lowered. This has been shown by Smith† in an investigation of sporadic broncho-pneumonia in cattle. When once virulent strains of members of this group of bacteria have penetrated into the circulation of susceptible animals, they cause either a true septicæmia or a meningitis or local abscesses according to their greater or lesser degree of virulence, the number gaining access to the circulation and the degree of resisting power of the animal. Indeed this organism appears to be capable of producing in several species of animals as great a diversity of symptoms and lesions as does the tubercle bacillus. When we remember that it is also capable of affecting almost all of the known domestic and many of the wild animals with a fatal form of disease, we appreciate the importance of early accurate diagnosis in all diseases in which the symptoms simulate those which may be caused by this bacillus.

5. The clinical diagnosis of hemorrhagic septicæmia in cattle from anthrax, black-leg and diplococcic cerebro-spinal meningitis, is exceedingly difficult. In fact, there is no typical history or chain of symptoms which may be relied upon. Fortunately, however, the post-mortem lesions are usually sufficiently definite to permit of a diagnosis by any veterinarian familiar with the disease.

Prior to the beginning of these investigations many deaths among cattle in Minnesota, as in other western states, were attributed to the so-called corn stalk disease. Though it is probable

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*Bureau of Animal Industry. Special Report on Cause and Prevention of Swine Plague, Washington, 1891, page 151.

†Bureau of Animal Industry. 12th and 13th Annual Reports, Washington, 1897, page 119.

that other diseases have been included under this term, it is worthy of note that since the study of hemorrhagic septicæmia was begun in Minnesota, all cases which were reported as corn stalk disease and which were investigated by this board, have proven to be hemorrhagic septicæmia.

In all outbreaks clinical and autopsy data should be supplemented by a careful bacteriological examination.

6. Attempts at treatment of cattle suffering from hemorrhagic septicæmia have proven futile. The production of an immunizing serum is a possibility as was shown in the experiments detailed in the former bulletin by this board. It was hoped that, when a place for the keeping of large animals for experimentation near the laboratory had once been obtained, the experiments in immunization could be carried forward. The research laboratory of the board was occupied first in December, 1902. Since then it has been necessary for the laboratory to devote most of its time to the investigation of swamp fever and cerebro-spinal meningitis in horses. It is to be regretted much that the removal of veterinary matters from the jurisdiction of this board renders it impossible for the laboratory to continue the experiments, which promised so well, toward the production of an immunizing serum for hemorrhagic septicæmia.

7. The prompt removal of the dead animals and isolation of sick ones, accompanied by thorough disinfection by fire, carbolic acid, corrosive sublimate and freshly slacked lime has apparently served to check each outbreak within a short time where the measures have been carefully and persistently carried out. The greatest difficulty has been in segregating the animals which, though infected, showed no symptoms until from six to 24 hours before death. The splitting up of the herd into small groups in separate pastures has been the most successful method of segregation.

In only one outbreak, No. 67, has any difficulty been experienced in stopping the progress of the disease. In this it seems probable that infected animals were placed with the supposedly uninfected ones. It is interesting to note that in this outbreak, as also in Outbreak No. 1 (see bulletin), the use of blackleg vaccine had no immunizing effect.

ANTHRAX.

In portions of America this disease claims victims numbering into the thousands each year. The southern states are the greatest sufferers because of the facility with which the disease is spread, owing to climatic and other conditions, but many of our northern states are heavy losers. Minnesota has been especially fortunate in keeping free from anthrax during the past three years.

A number of outbreaks occurred in South Dakota during the summer of 1901, and the advisability of adopting quarantine measures against that state were seriously considered. Before taking such action it was decided than an investigation should be made in order that we might be familiar with the existing conditions and assure ourselves that the prevailing disease was true anthrax. The possibility of another disease being present (hæmorrhagic septicæmia), which was being mistaken for anthrax, was not lost sight of. The C., M. & St. P. Ry. Co. kindly furnished transportation, and on Aug. 16, 1901, Dr. Brimhall, in company with Dr. J. P. Foster, state veterinarian of South Dakota, began a tour of investigation in the infected regions. The disease had been prevalent in some sections of the state for a number of years and little or nothing had been done to check its spread until Dr. Foster took charge of the work. Through his efforts many hundred head of cattle were vaccinated and other precautionary measures instituted. One farm was visited where thirty-six head of cattle had died some four weeks previous. On the range near the stable there was one cow in a very weak and emaciated condition, which the owner stated was taken sick at the time and in the same manner as the ones which had died. With the owner's permission she was killed and an autopsy made at once. Chronic lesions were found, showing that hæmorrhages into the lymph glands and other organs had occurred early in the disease. Cultures and fresh specimens were obtained which were taken to the Minnesota State Board of Health Laboratory. Later reports from the laboratory confirmed the suspicion that the disease was hæmorrhagic septicæmia, Dr. Wilson having obtained pure cultures of *B. Bovisepticus* from part of the material.

While driving across the prairie on the return trip the veterinarians noted above observed in the distance what appeared to be the carcass of some large animal. On closer inspection it proved to be the dried hide and bones of a steer. Lime had been freely

scattered over the hide. This was an indication that the owner believed the animal had died from anthrax. A small portion of the dried skin from this carcass was taken to the Minnesota State Board of Health laboratory. This portion of skin, one and a half inches long and about one-fourth inch wide was shaved from the region of the shoulder, where it had cracked open. From this bit of skin virulent cultures of anthrax bacilli were grown.

Anthrax has been found present in Minnesota during the last seven years of the board's work in but one locality (see Biennial Report, 1899-1900, page 454), although a number of examinations have been made for it. Many examinations for actinomycosis, anthrax and blackleg in man have proven to be streptococcus infection.

Laboratory Observations. *Case 1, Anthrax (Cattle)*—June 13, 1901, there was received in the laboratory a small quantity of greenish-yellow fluid in a bottle from Dr. L. A. Faulkner of Good Thunder, Minn. This specimen was collected from a case of some obscure disease in cattle, resembling anthrax. Direct coverslip preparations and cultures on serum and agar showed numerous bacilli and cocci, but none even remotely resembling bacillus anthracis.

Case 2—A report and examination of specimens of supposed anthrax from Blunt, S. D., is given under hæmorrhagic septicæmia, page 90.

Case 3—April 9, 1902, there was received in the laboratory a portion of spleen, accompanied by the following letter, from Rochester:

Dear Doctor: I send by mail a section of spleen taken from a yearling steer supposed to have died from blackleg. The carcass was 12 hours' old when I held the post, and was inclined to believe it to be a case of anthrax, though I could not give a decided opinion. Dr. Granger mounted a specimen for me and called it anthrax. I would like to have it verified so send you a piece of same spleen. Kindly let me hear from you at once so I can inoculate the herd with the proper vaccine. Yours truly.

EDWARD L. KALB.

Direct coverslip preparations and anærobic and ærobic cultures showed the presence of a putrefactive bacillus, *B. coli communis*, and many streptococci. Neither the bacilli of anthrax nor of symptomatic anthrax were present.

Case 4—This specimen in man is herewith reported because of its supposed origin from cattle.

Jan. 23, 1903, there was received in the laboratory from Dr. J. H. Beatty, St. Cloud, Minn., a serum culture of swab taken from

the hand of one of the officers at the St. Cloud State Reformatory, accompanied by the following letter from Dr. Beatty:

> Enclosed in this smear box is a culture taken from an undoubted contagious skin disease that is endemic in the State Reformatory. This culture was taken from a sore on the hand of one of the officers. These sores resemble ringworm at first and then develop not unlike anthrax and are confined almost exclusively to barn men. If possible I would like a diagnosis.
>
> J. H. BEATTY.

The cultures from the swab and serum tube were sown into broth and on agar and fresh serum. After twenty-four hours in the incubator only staphylococci and streptococci developed. Subsequent cultures showed these to be staphylococcus pyogenes albus and streptococcus pyogenes. No other organisms were found in any of the cultures or in any coverslip preparations made from the original swab. Sections of tissue and fresh material were asked for, but could not be obtained, therefore histological study could not be made.

In connection with the presence of streptococci in these specimens reference should be made to the evident infection with streptococci of swine in the herd at the same institution. See page 88.

Feb. 3, 1903, there was received from Dr. Beatty another specimen consisting of a swab inoculated from the hand of a patient at the State Reformatory at St. Cloud, and several coverslip preparations. The coverslip preparations were stained with eosin and methylene blue, but showed no bacteria. Cultures made in broth and on agar and on serum showed a yellow white staphylococcus only.

Case 5—This specimen in man is herewith reported because of its supposed infection from cattle.

Feb. 14, 1903, there was received in the laboratory, through the Secretary of the State Board of Health, a specimen from a case of supposed anthrax, occurring in the practice of Dr. De Coster of Worthington, Minn. The patient, a young man, Mr. J. W., was a butcher. He had a crop of what appeared to be small boils about the left wrist. There were a few points of suppuration on the right wrist also. There were no symptoms of serious illness. Patient had had at no time a high temperature. The specimen consisted of an inoculated diphtheria swab and serum tube collected by Dr. Bracken.

The specimen was examined in direct coverslip preparations and in cultures in broth and on agar and on serum. Only streptococcus pyogenes and staphylococcus aureus and albus were present.

SYMPTOMATIC ANTHRAX.

This disease is causing the stock owners of this state but little trouble. The outbreaks have been few and were readily controlled by the use of vaccine. Reports that blackleg has existed in the following counties have been received: Meeker, Swift, Stearns, Polk, Sibley, Watonwan, Grant and Sherburn.

In a few instances blackleg has been encountered while investigating a disease the nature of which was unknown. The following extracts from the office records give a short account of some of these cases:

Oct. 25, 1900, went to McIntosh, Polk County, to make inquiry concerning cattle that had been reported to us as having died from some unknown cause. The information as to symptoms was unsatisfactory, but blackleg had been present in that neighborhood for the past two or three years, and it would seem quite probable that this disease had caused the death of the cattle under investigation.

Nov. 3, 1900, went to Madelia, drove out to Dr. C.'s farm and made an autopsy on a steer which had been dead about eighteen hours. While the symptoms were not characteristic, the evidence seemed sufficient to pronounce the disease blackleg. Specimens taken to the laboratory contained the bacillus of symptomatic anthrax, and this confirmed the clinical diagnosis.

Oct. 22, 1901, Drs. Brimhall and Wilson visited four farms two miles south and two miles east of Green Isle, Minn., and made autopsies on the bodies of two calves, one of which had been dead forty-eight hours, and the other was killed when almost dead for purposes of autopsy.

The following history of the outbreak was obtained:

Thursday, Oct. 17, 1901, there was found dead in a herd of cattle belonging to four or five farmers, four head of young cattle (calves, yearlings and two-year-olds). Between that time and the following Tuesday nine more died. None were over two years old and most of them were spring calves. All died within a few hours after the first symptoms were observed or were dead when found in the pasture. None exhibited any swelling. All of the animals except those noted above had been burned without skinning or opening.

One spring calf, which had died forty-eight hours before, the property of Mr. J. D. B., was in a rather advanced state of decomposition when examined. On the right flank and leg was a large blackened area which extended deep into the muscular tissue, which was quite black. A few small, apparently ante-mortem hæmorrhagic areas were found on the ventricles of the heart. The other lesions, if any existed, were too much obscured by the post-mortem changes to permit of any certainty in statements regarding them. It may be added that all of the tissues were markedly infiltrated with gas.

In the adjoining pasture, Mr. M. had three calves sick, one of which was almost dead. It was killed and immediately examined. On removing the skin no lesions were found. Internally, the peritoneum and a large portion of the stomach and bowels was found to be covered with a bloody exudate which was rather dark red and of a somewhat dry, plastic nature. The color was markedly different from that observed previously in cases of hæmorrhagic septicæmia. One or two small hææmorrhages were found on the right auricle of the heart. The muscles about the left hip joint were blackened. No gas was apparent in these muscles.

Owing to the history of the disease and the age of the animals affected, the localized lesion of blackened muscle in the first calf and similar condition in the second, a provisional diagnosis of symptomatic anthrax was given at the time and vaccination advised.

Direct coverslip preparations and cultures from the gluteal muscle, diaphragm, heart's blood, spleen and surface of peritoneum were taken. Direct coverslip preparations stained with eosin and methlyene blue showed from calf No. 1, a large spore-bearing bacillus, in which the spore was somewhat oval and located near but not directly at one end. From calf No. 2 was a more slender bacillus about the same length as that found in calf No. 1, but containing no spores. Cultures were grown both ærobically and anærobically. Aerobic cultures from calf No. 1 developed *B. coli communis (?)* from all sources. Those from calf No. 2 no bacteria except one colony of white staphylococcus on one of the two serum cultures from the gluteal muscle, probably a contamination.

Anærobic cultures from both calves 1 and 2 developed bacilli of symptomatic anthrax and from calf No. 1 a large putrefactive bacillus and *B. coli communis.*

Dr. Brimhall visited the farm of Mr. L. L. B. on Nov. 5, 1902, to investigate cause of death among cattle. They had lost five head of yearlings and two-year-olds. His herd consisted of about sixty

cattle of all ages. The men who had skinned the animals stated that a number of bruised spots were noticed under the skin on some of the animals, but the owner had not noticed any swelling except upon the last one taken sick. This animal was still unburied, although it had been dead three days.

An autopsy was made and typical lesions of blackleg were found. The other animals were unburied and the heavy muscles of the legs were cut into, but no signs of blackleg tumors were found. From the description given by the parties who had removed the skin it seemed possible that some of these animals might have died of hæmorrhagic septicæmia, but the owner was advised that blackleg existed without question and it would be to his interest to vaccinate the rest of the young animals.

Nov. 6, 1902, there was received in the laboratory through Dr. Brimhall a portion of muscle from the calf noted above. Direct coverslip preparations and anærobic cultures showed the presence of the bacillus of symptomatic anthrax.

Nov. 6, 1902, guinea pig No. 557, weight 350 grammes, was inoculated subcutaneously in the right groin with one c.c. of the broth emulsion from the above case. The animal was found dead on the morning of Nov. 7. The muscles and subcutaneous tissues about the site of inoculation and extending over the abdomen were black and filled with gas. The bacilli of symptomatic anthrax were present in the blood smears and in anærobic cultures.

Subsequently Mr. B. stated that he had lost a three-months'-old calf suddenly after Dr. Brimhall's visit. He then vaccinated his herd with blackleg vaccine and lost no other animals.

The importance of the laboratory diagnosis in doubtful cases of blackleg is readily perceived when the resemblance between this disease and some forms of hæmorrhagic septicæmia is remembered.

ACTINOMYCOSIS.

From inquiry made of veterinarians throughout the state concerning the prevalence of the disease it would seem that it was on the increase, in some localities at least. Many of these cases are successfully operated on when taken in the early stages of the disease, but if it is a fact that this disease is on the increase it is important that steps be taken to determine the method by which it is spread. It is to be hoped that this work will be undertaken by some investigator in the near future. The experiment stations of this country have the best opportunities for solving this important question.

The total number of such infected animals killed at New Brighton, during this period, under inspection, is 209. These cattle were from points representing all sections of the state.

Laboratory Observations. The following examinations have been made in the laboratory for suspected actinomycosis:

Although this disease is fairly widespread through this state, it will be noted that few specimens come to the laboratory for examination, since in most cases a clinical diagnosis can readily be made.

Case I (Man)—This case is reported here because the infection was supposed to have come from the cattle.

Jan. 22, 1902, there was received in the laboratory a small vial containing bloody fluid. Accompanying this was the following letter:

North Branch, Jan. 21, 1902.

Dear Sir: I send you under separate cover a sample of pus taken today from a suppurating gland just below the left jaw. I have reason to believe it is of actinomycotic origin. The patient came to me first in June last with an abscess of the gland under the right jaw. At the same time she had a suppurating submaxillary gland. Since that date I have repeatedly opened the suppurating gland in the neck and in the throat. The granular form of the pus has led me to suspect the character and lead me to think the disease a true actinomycosis. A true report of the condition of the pus will greatly oblige,

OSCAR O. FLIESBURG.

Careful microscopic study of stained preparations failed to show anything which resembled actinomyces. Numerous preparations were stained with carbol fuchsin, destained with acid and

counterstained with methylene blue for tubercle bacilli, but with negative results.

Case 2 (Man)—This specimen in man is here reported because of its supposed infection from cattle.

Feb. 8, 1902, there was received in the laboratory a specimen of pus, accompanied by the following letter:

Gary, Minn., Feb. 8, 1902.

Dr. F. F. Wesbrook, Minneapolis,

Dear Doctor: I send you a specimen of pus taken from swelling in the submaxillary region of a man, 62 years of age. One month ago he first noticed a swelling in said region, not much pain, but has steadily increased in size, and lately taken a reddish hue. I drew off about a pint of thin stained pus. It looks to me very much like actinomycosis. The patient has a tuberculous history.

FREDERICK O. GRONVOLD.

Microscopic examination of the specimen showed an abundance of bacteria of divers kinds, including many bacilli of various sizes, diplococci and a few streptococci. Tubercle bacilli were not demonstrated, although of course this did not eliminate the possibility of their presence in the pus. No actinomyces could be found.

Case 3 (Man)—This supposed case of actinomycosis, although occurring in man is herewith reported because of a supposed infection from cattle.

Dec. 5, 1902, there was received in the laboratory a small piece of tissue, accompanied by the following letter:

Mankato, Minn., Dec. 4, 1902.

Dr. F. F. Wesbrook, Laboratory State Board of Health, Minneapolis.

Dear Doctor: We send you by this afternoon's mail, a piece of tissue removed from the middle phalynx of the middle finger of a patient who was in our office this morning.

The patient is a man 66 years of age. Has always been in good health. Between Sept. 15th and 20th, 1901, a sore began to form on the right wrist on its dorsal and external surface. It began with an appearance, he says, of a ringworm. This was cut out. Soon after this the trouble began on the dorsal surface of the middle phalynx of the middle finger. There is also trouble, similar on skin over the proximal end of phalanx of the same finger. Five weeks ago he bruised his wrist and following that the condition similar to the first began there at the edge of the scar. These eruptions are granular in appearance and painless. There is some induration at their bases. They are somewhat granular. There is some discharge of pus containing small yellow particles. There are white nodular appearing masses over the surface which he says first made their appearance after using an ointment which he was given. The two sores on the wrist are each about two by three inches in diameter. There is no glandular enlargement.

He gives a history of having cared for a cow which had a swollen and sore udder. He milked the cow and dressed the wounds which, after the purulent discharge, had been left. This udder suppurated in several places and a large slough separated from it. The cow apparently recovered after a time. The sores on his hand began soon after he had cared for this cow. He knew that on his finger there was an abrasion of the skin. We thought you would be interested in this case, and we would like to know the bacteriology and pathology of this case if possible.

Very respectfully,

DRS. ANDREWS, HOLBROOK & OSBORN.

The specimen consisted of a small piece of tissue showing one skin surface. After the removal of material for cultures (which remained sterile after several days in the incubator) the tissue was fixed in alcohol and formaldehyde and imbedded in parrafin, cut and stained by various methods. There was no evidence of actinomycosis, blastomycosis, tuberculosis, epithelioma or carcinoma in the tissue. It resembled in structure and arrangement a warty or papillomatous growth. There was some infiltration with leucocytes and other evidence of proximity to inflammatory foci.

A voluminous correspondence failed to elicit any new facts concerning the history of the case, and since the patient had left Mankato it was impossible to obtain any other specimens of tissue.

Case 4 (Man)—This specimen is here reported because of its supposed infection from cattle.

March 6, 1903, there was received in the laboratory a specimen of a tumor, accompanied by the following letter:

Dear Doctor: I take the liberty of sending you by express one-half of a tumor removed from the scalp of a boy. I suspect it to be actinomycosis but I have not been able to find the mycelium. There is some doubt between this diagnosis and possible tuberculosis. The boy hurt his head last fall. The wound healed up but three or four weeks later started to grow, and when he came to see me the tumor was as large as a small orange. Pus ran out all around it and it was quite painful to touch. One axillary gland (right) was enlarged. He has also enlarged lympathic glands under the maxilla although very small.

I first thought it was a sarcoma, but gave up this diagnosis in behalf of actionomycosis. There was a small spot on the neck (the size of a penny) and suppurating; another small spot in the right cheek. The specimen is in alcohol.

Yours truly,

J. LYNN.

Since the specimen was in alcohol when received in the laboratory only a histological examination could be made. Sections were cut from four different areas and stained by various methods. The

histological diagnosis lay between round celled-sarcoma, and an infectious process. No bacteria of any kind were found, nor any actinomyces. It may be possible that the alcohol was not sufficiently strong to fix any parasites had they been present. Thus actinomycosis could not be excluded as a possible diagnosis. No tubercles were present in the tissue.

Case 5 (Cattle)—Oct. 10, 1902, Dr. Beckman visited the State Experiment Station and collected cultures of pieces of tissue from a tumor of the lower jaw of a young heifer. The culture showed an organism resembling actinomycosis on broth, but this did not grow upon any solid media. The pieces of tissue showed actinomyces in great abundance.

Case 6 (Cattle)—Feb. 2, 1903, there was received in the laboratory a small tin box containing some thick tenacious pus. On the same date was received the following letter concerning it:

> Dear Sir: My cows have bunches about two by three inches in diameter under the jaws; some have one and others have two. The bunches are very solid. One some of them we put "lump jaw cure" and they disappeared, loosening the skin so that it hangs loose, and drops off. One lump we cut open with a knife. It contained pus, which I herewith send to you in a small tin box. Please examine it and then let me know what the disease is. Box has been boiled according to Dr. Brimhall's direction, so it was thoroughly clean before using. The lumps or balls will slip up and down under the skin. It is a very hard task to cut them. The doctors here call it "skin lump jaw." Yours very truly,
>
> W. H. R., Gary, Minn.

The specimen was examined in direct coverslip preparations and in cultures. There were no actinomyces present. Two different kinds of bacilli were obtained in the cultures. One produced a white, abundant growth on solid media somewhat resembling *B. coli communis.* Serum was not liquefied by this organism, but milk was rendered acid, coagulated and later digested. The other micro-organism was a bacillus which produced a yellow pigment, but did not liquefy serum and alkalinized milk without coagulating it.

MALIGNANT CATARRH IN CATTLE.

Several outbreaks of this fatal disease have come under the notice of this board. One of these was reported in the Biennial Report for 1899-1900, pages 274 and 453, as occurring in New Market Township, Scott County, near Farmington, Minn. From five of the animals suffering with the disease on this farm, a very short, unevenly-staining, belted diplococcoid bacillus, highly pathogenic for guinea pigs and rabbits, was isolated from the cranial sinuses.

During the biennial period just closed, three outbreaks have been studied, as follows:

Farmington, Minn.—June 21, 1901, Drs. Brimhall and Wilson visited the farm of Mr. John Forstrom, in Eureka Township, Dakota County, seven miles southwest of Farmington, Minn., to investigate an outbreak of malignant catarrh in cattle. This herd consisted of thirteen head of cattle of varying ages. About a year previously one had died, and within two or three weeks three others had sickened and died. One yearling heifer had been sick five days at the time of the visit. Her temperature was 106.4°. There was a watery discharge from the left eye, which seemed much inflamed. There was a muco-purulent discharge from the nose. The animal was very thin and showed great depression. It was killed and an autopsy made at once. The gross pathological findings were entirely negative except a marked inflammation of all the serous membranes and of the mucous membranes of the nose and alimentary canal.

Cultures and direct coverslip preparations were made from the frontal sinus, inside of horn (one of which had fallen off and the other of which was readily removed), the anterior eye chamber, heart's blood, pericardium, hip joint and enlarged inguinal gland.

The direct coverslip preparations were stained with eosin and methylene blue and carefully examined. A few isolated pairs of minute diplococci or diplococcoid bacilli were found in one or more of the coverslips from the material from the horn, the eye and the hip joint. None were found in any of the preparations from any of the other sources and no other bacteria of any kind were observed in any of the preparations.

Cultures examined after thirty-six hours in the incubator. Horn—One of the two broth cultures showed a few minute diplococci, streptococci or diplococcoid bacilli in very short chains.

The serum cultures showed none. One of the two serum cultures from the frontal sinus showed a few diplo-bacilli (similar to those from the horn) in the water of condensation. None in the other serum cultures nor in the two broth cultures. One broth and both serum cultures from the anterior eye chamber showed diplo-bacilli, the same as those from the horn. The other broth culture contained a heavy film made up of long slender bacilli, probably a contamination from the air. One broth and one serum culture from the pericardial fluid showed a few diplo-bacilli and streptococci, the same as from the horn. The other broth and the other serum culture showed no bacteria. From the hip joint, one broth and one serum culture showed the diplo-bacilli. The other broth and the other serum culture showed no bacteria. No bacteria were found in any of the four cultures from the enlarged inguinal gland nor in any of the nine abundantly sown broth cultures from the heart's blood.

It will be noted that no bacteria except the diplo-bacilli and one contamination (see above) were found in any of the cultures and that this was present very sparingly in one or more of the several cultures from the horn, frontal sinus, anterior eye chamber, pericardial fluid and hip joint, while absent entirely in the cultures from the inguinal gland and the heart's blood. Second cultures from the original ones from the horn and hip joint were sown abundantly on serum and in plain broth, grown twenty-four hours in the incubator and used for the inoculation of rabbits Nos. 438-39-40-41 and guinea pigs Nos. 437-38-39-40.

Rabbit No. 438, weight 1,725 grammes, was inoculated June 26, 1901, in the left subdural space with 0.2 c.c. of an emulsion of a twenty-four-hour broth and a twenty-four-hour serum culture second from original diplo-bacilli (?), isolated from the horn of heifer noted above. Animal was found dead July 9, 1901. An autopsy showed some purulent discharge from the right nostril; considerable inflammation of the meninges of the brain; brain not apparently softened; trachea contained considerable mucus; bladder was distended. No other gross lesions were observed.

Cultures in broth and on serum were made from the meninges of the brain and from the heart's blood. Direct coverslip preparations from the meninges showed no bacteria nor were there any found in those from the heart's blood. Cultures in broth and on Löffler's blood serum from the meninges showed a few diplo-bacilli. Those from the heart's blood gave no growth.

Rabbit No. 439, weight 1,400 grammes, was inoculated June 26, 1901, in the left subdural space with 0.2 c.c. of an emulsion of a twenty-four-hour broth and a twenty-four-hour serum culture second from original diplo-bacillus isolated from hip joint of heifer noted above. The animal was alive and well six months later, having shown no symptoms in the meantime.

Rabbit No. 440, weight 1,235 grammes, was inoculated June 26, 1901, intraperitoneally with 1.5 c.c. of an emulsion of a twenty-four-hour broth and a twenty-four-hour serum culture second from original diplo-bacillus isolated from horn of heifer in case noted. Also 0.5 c.c. of same material as noted above was injected high into the right nostril. July 14, 1901, the animal was apparently sick and not eating properly. July 15, the animal had intense diarrhœa, and July 16 it was found dead at 9 a. m. At autopsy, no gross lesions were found except some inflammation of the mucosa of the intestine. No bacteria were found in direct coverslips or cultures from lung, heart's blood, spleen, liver or peritoneal fluid.

Rabbit No. 441, weight 1,670 grammes, was inoculated intraperitoneally June 26, 1901, with 1.5 c.c. of an emulsion of twenty-four-hour broth and a twenty-four-hour serum culture second from original diplo-bacillus isolated from the hip joint of heifer noted above. Also 0.5 c.c. of the same material as above was injected high into the right nostril. After five months the animal was still alive, having shown no symptoms in the meantime.

Guinea pig No. 437, weight 625 grammes, was inoculated on June 26, 1901, in the left subdural space with 0.2 c.c. of a twenty-four-hour broth and a twenty-four-hour serum culture second from original diplo-bacillus isolated from the horn of heifer in case noted above. The animal was found dead July 7, 1901. Brain and meninges were congested. Skin wound was open. No special areas of inflammation at the site of inoculation. There was an increased amount of peritoneal fluid which was blood tinged. The parietal peritoneum was congested; the bowel contents were fluid and a considerable portion of the mucosa of the small intestine was congested. The liver, spleen and kidneys were microscopically normal. Cultures from the peritoneal fluid after twenty-four hours in the incubator showed an abundant growth of a minute diplo-bacillus similar in appearance and staining reaction to the organism originally inoculated subdurally. From the meninges and heart's blood a few colonies of the same organism was obtained.

Guinea pig No. 438, weight 740 grammes, was inoculated June 26, 1901, in the left subdural space with 0.2 c.c. of an emulsion of a

twenty-four-hour broth and a twenty-four-hour serum culture second from original diplo-bacillus isolated from hip joint of heifer noted above. The animal jumped during the operation and the brain was probably somewhat injured. Dead June 30, 1901. At autopsy extensive extravasation of blood was present in the subcutaneous tissue over the skull. The brain was very soft with considerable hemorrhage at site of inoculation.

Direct coverslip preparations from the meninges showed no bacteria, but cultures in broth and on serum from the same source showed a few colonies of diplo-bacilli indistinguishable from those inoculated. Similar preparations from the heart's blood showed no growth.

Guinea pig No. 439, weight 455 grammes, was inoculated June 26, 1901, intraperitoneally, with 1 c.c. of an emulsion of a twenty-four-hour broth with a twenty-four-hour serum culture second from original diplo-bacillus, isolated from horn of heifer in case noted above. Also 0.4 c.c. of the same material as above was injected high into the right nostril. Animal still alive and well four months later, having exhibited no symptoms in the meantime. Animal was used for another purpose.

Guinea pig No. 440, weight 395 grammes, was inoculated June 26, 1901, intraperitoneally with 1 c.c. of an emulsion of a twenty-four-hour broth with a twenty-four-hour serum culture second from original diplo-bacillus isolated from hip joint of heifer in case noted above. Animal was also given 0.4 c.c. of the same material as above high into the right nostril. No symptoms having arisen four months later, the animal was used for another purpose.

It will be seen from the above inoculations:

(1) That the extremely short diplo-bacillus or dipococcus isolated from this case was similar to that isolated from the case noted in the last Biennial Report, page 453. If this organism is not a variety of *bacillus haemorrhagica septicaemiae*, it is closely related thereto.

(2) That this diplococcoid bacillus, when inoculated subdurally in guinea pigs and in one rabbit, produced inflammation of the dura, while in guinea pig No. 437, a catarrhal inflammation in addition was present in the peritoneum and intestine.

(3) Intraperitoneal inoculations in both guinea pigs and rabbits were negative except in rabbit No. 440.

(4) From all of the animals, rabbits and guinea pigs, that is, which died after inoculation with this organism, the organism was recovered in pure culture.

(5) While the above mentioned inoculations are interesting, they need to be supplemented by inoculations in cattle before any conclusions can be drawn therefrom.

Underwood, Otter Tail County—Oct. 24, 1901, Drs. Brimhall and Wilson visited the farm of Ole Hagan, four miles north of Underwood, Minn., and made an autopsy on the body of a two-year-old steer, dead sixteen hours previously from malignant catarrh.

In July, 1901, Mr. Hagan had lost a heifer with the disease. She had been in pasture in a herd two miles away from home, and when she became sick was brought home, where she died within a few days. She was kept while at home in an old shed near the barn. In August, another heifer died. She had been running in a field adjoining the shed and to which they occasionally had access. October 0th, the steer which was examined became sick. He also had been running with the cattle in the distant pasture, but had been with the home herd while both of the previously mentioned animals were sick. He died October 23rd, about 6 p. m. The weather at the time was cool and not much decomposition had set in when the examination was made, October 24th.

A very offensive discharge was present from the nostrils. On removing the lower jaw, the posterior pharynx was found to be studded with small ulcers and the whole surface covered with a yellowish, plastic, foul-smelling exudate. The horns were somewhat loose, and on removal showed the lining membranes very markedly inflamed. One hip joint, when opened, showed a large quantity of blood fluid within the cavity. There had been some inflammation of the pleura, peritoneum and pericardium.

Direct coverslip preparations and serum and broth cultures were made from the interior of the horn, eye chamber, pharynx, pleura, pericardium, gall bladder and hip joint. A piece of ulcerated tissue from the upper pharynx was placed in 96 per cent alcohol for histological study.

Direct coverslip preparations stained with eosin and methlyene blue from the interior of the horn and hip joint showed numerous small diplococci or diplococcoid bacilli. Those from the pericardial fluid and eye chamber showed the same micro-organism, and in addition, small, motile bacilli, probably *B. coli communis.* Those from the gall bladder and heart's blood showed *B. coli communis* (?) and a large putrefactive (?) bacilli. Those from the throat showed a great number and variety of bacteria.

Cultures in broth and serum from the interior of the horn and hip joint showed many small diplococci or diplococcoid bacilli simi-

lar to those found in the direct coverslip preparations. In addition the cultures from the horn showed a few large putrefactive (?) bacilli. Cultures from the pericardial fluid and the eye chamber showed the same diplococci or diplococcoid bacilli in small numbers and great numbers of the large putrefactive (?) organism as well as *B. coli communis*. Cultures from the heart's blood and gall bladder showed only *B. coli communis* and large putrefactive bacilli. Cultures from the throat contained a great variety of micro-organisms, though the diplococcus found in the horn, hip joint, eye chamber and pericardial fluid was apparently absent. Pressure of other work at this time prevented the making of animal inoculations.

St. Martin's Township, Stearns County—Feb. 6, 1902, Dr. Brimhall visited the farm of Mr. C. P. Rausch, St. Martin's Township, Stearns County, to investigate an outbreak of cattle disease. Mr. Rausch had originally a herd of fifty-seven cattle. During the month or two previous to Dr. Brimhall's visit, nine had died with symptoms similar to those exhibited by five others sick at the time of Dr. Brimhall's visit. About twenty-five of the cattle were kept in the stable. The others were kept in other places. None of those which had been kept outside of the stable had been sick at any time, though there were a number of steers of this group which ran with the sick cattle during the daytime.

One animal, cow No. 1, had been taken sick on February 4th, was seen on the evening of February 6th, when her temperature was 104.5°. There was profuse diarrhœa, discharge from the nose and eyes and the conjunctiva of the eyes were very much inflamed. Animal was very much emaciated, not having taken food since the first day of her sickness. On the morning of the 7th she was killed by a blow on the head and an autopsy made. There were no pathological lesions of any moment found except a slight catarrhal inflammation of the mucuous membranes throughout.

Cultures were taken from the anterior chamber of the eye, from the horn cavity, from pericardial sac, heart's blood, anterior mediastinal lymph gland, spleen, kidney, hip joint, the interior of the uterus and from the udder. Also took an eye and lymph gland with capsule and portion of spleen and kidney. These were placed in Cohansey jars and small portions of the spleen, liver, kidney and lymph glands were placed in alcohol. These were all kept cool and brought to the laboratory and cultures placed in the incubator, at 1 p. m., Feb. 8, 1902.

Cultures were made from pieces of the spleen, kidney and eye and a gland brought to the laboratory by Dr. S. D. Brimhall; also smears. The smears stained with methylene blue and eosin showed no bacteria. After forty-eight hours the cultures showed no growth.

Of the cultures taken by Dr. Brimhall, at the autopsy, there was a growth of those from the eye, hip joint, milk, gland from the anterior media stinum, horn cavity and kidney. The growth from the eye showed a large clear-staining spore-bearing bacillus which liquefied serum. From the hip joint there was obtained a short, solid staining bacillus and a diplococcus or diplo-bacillus. A diplococcus or diplo-bacillus in pure culture was obtained from the milk and the gland from the anterior media-stinum. The growth from the kidney showed a granular staining bacillus somewhat resembling diphtheria bacilli. The growth from the horn cavity showed a large bacillus which liquefied serum.

Since a diplococcus or diploccoid bacillus had been found in other cases of malignant catarrh it was supposed that the diplobacillus was the pathogenic organism and the cultures which did not show the diplococcus or diplococcoid bacillus were set aside.

Rabbit No. 522, weight 1,527 grammes, was inoculated Feb. 15. 1902, in the left ear vein with 1 c.c. of a twenty-four-hour broth with a twenty-four-hour serum culture of the diplococcus obtained from the tissue of cow No. 1. This animal showed no symptoms during the ensuing two months, after which time it was used for another purpose.

Guinea pig No. 495, weight 557 grammes, was inoculated Feb. 15, 1902, intraperitoneally with 2 c.c. of a twenty-four-hour broth with a forty-eight-hour serum culture of the diplococcus isolated from the udder of cow No. 1. This animal showed no symptoms during the ensuing month.

Feb. 14, 1902, Dr. Brimhall again visited the farm of Mr. Rausch, where he found that three of the five cattle which had been sick on February 7th had died and that three others had become sick, two of which had died. Two of those which were sick at the time of Dr. Brimhall's first visit were now improving. One of these, cow No. 2, was killed and an autopsy made. The post-mortem findings were similar to those in cow No. 1. Direct coverslip preparations and serum cultures showed a small diplococcus or diplococcoid bacillus from the horn cavity and hip joint.

Rabbit No. 523 was inoculated Feb. 18, 1902, into the left ear vein with 1 c.c. of an emulsion of a twenty-four-hour broth and a

twenty-four-hour serum culture of the organism from hip joint of cow No. 2. This animal showed no symptoms during the ensuing month, when it was used again for another purpose.

Guinea pig No. 498, weight 355 grammes, was inoculated intraperitoneally, Feb. 18, 1902, with 1 c.c. of an emulsion of a twenty-four-hour broth with a twenty-four-hour serum culture of the diplococcus isolated from the hip joint of Rausch cow No. 2. The animal showed no symptoms during the ensuing three months, at the end of which time it died of pneumonia during an epidemic among other guinea pigs in the same building.

At the time of Dr. Brimhall's first visit to Stearns County, he found that Mr. Anton Knese, living near Torah, had lost sixteen head of cattle with what he thought was the same disease as that causing the death of Mr. Rausch's cattle. Mr. John Loeckes had lost four head during the winter and Mr. Jos. Schaeffer lost eighteen head sometime before with what they thought was the same disease as had caused the death of Mr. Rausch's cattle.

It will be seen from the above that the investigation of these latter cases was somewhat unsatisfactory from the laboratory standpoint, since the materials were collected under unfavorable conditions and of the few inoculations that were made none proved to be successful. At the time the outbreak occurred, pressure of other work in the laboratory was so great that it was impossible for anyone to accompany Dr. Brimhall to collect specimens. At that time as well as during all previous investigations of this disease, the laboratory had at its disposal no place where large animals could be kept. It was therefore impossible to make inoculations of cattle as should have been done.

That the disease, malignant catarrh, is one which causes considerable loss to the farmers of Minnesota, there can be no doubt. This investigation should be persistently pursued at every opportunity. From the experience of this board, there would seem to be little hope of accomplishing anything concerning the etiology of the disease without the inoculation of bovines. Since the board has been in a position to make such inoculations, i. e., since Jan. 1, 1903, no cases have come to its attention.

SUNDRY DISEASES OF CATTLE.

Pleuropneumonia (?)—*Edmunds, S. D.*—June 22, 1902, there was received in the laboratory from Dr. J. P. Foster, State Veterinarian of South Dakota, specimens of lungs of cattle. Accompanying the specimen was the following data:

"I was called to inspect a herd of cattle in Edmunds County, S. D. The owner told me over the telephone that the cattle were affected with the following symptoms: Cough, nasal discharge, and great emaciation. I suspected tuberculosis even after seeing the cattle and before making a post-mortem. They are a lot of scrub stuff and were brought in from Sioux City about a year ago, when they were yearlings and were sold off in different bunches. As I understand it they were picked up in Minnesota and Iowa. I think they are skim milk calves of promiscuous breeding. The party who now has this stock got them in the herd in 1901, and at this time he noticed them coughing. Although they had the best of food all summer they steadily became poorer, and when seen by me a number of them were in bad shape. In starting them up they began to cough. The coughing is very husky. They also have a discharge from the nose on exertion. A number of them have died during the summer and fall, and the owner said they smelled very badly some time previous to their death.

"I made post-mortem examinations of two with the following results: Lungs in very bad shape, showing hepatized areas with very distinct lines of demarcation between the hepatized and normal lung tissue. These hepatized areas, some of which were about the size of a man's hand, were thicker than the healthy areas and bloated up at the line of demarcation. In cutting through the hepatized areas and squeezing the diseased portion a fluid oozed out of bronchioles which resembled somewhat the juice of milk-weed, but more yellow in color. The lining of the bronchioles was of a dirty gray color.

"The pleura was much thickened in spots and in some places there was air between the costal pleura and the lungs, so that it looked like a lot of bubbles, and at first glance resembled tuberculosis. There were numerous adhesions of the visceral and parietal pleura and also hydrothorax. There were no tubercular lesions whatever.

"I understand that there is another herd about five miles from this place where the cattle are affected in the same manner. They came from the same lot I believe, and were shipped in from Sioux City. This disease presents the lesions of pneumonia and pleurisy, and is undoubtedly contagious. Can it be possible that it is true contagious pleuropneumonia? The temperatures of these cattle were from 103.5° to 105°. I was careful to take the temperatures without exciting the animals; in fact, they were so weak that it was possible to get right up to them without their making much effort to run away."

In an additional note Jan. 21, 1902, Dr. Foster says: "The specimen of lungs and postmediastinal gland were taken from the same animal. The time was limited and we got the first one handy. The hepatization is not at all marked in this case. Neither do the lungs show the swollen hepatization, and the pleural adhesions are plainly seen. I enclose lymphatic gland as a possible aid to diagnosis. The pus formation is the only thing that might indicate tuberculosis in this case."

The specimens received at the laboratory were those described in the second note by Dr. Foster. The description in Dr. Foster's first letter was concerning specimens sent to the Bureau of Animal Industry. The specimens reached the laboratory in good condition on January 22. The lungs on section were found to contain little exudate.

Direct coverslip preparations from the lungs showed a large nonmotile bacillus which produced a white growth on agar and serum and a heavy creamy growth on potato and reddened litmus solutions. From the pus cavity a granular looking growth was obtained. This grew very rapidly on all media, produced no change in litmus media and no growth on potato. Celloidin sections of the edge of the abscess and also of the lung at some distance from the abscess were made. At the edge of the abscess there was an overgrowth of connective tissue, but with no infiltration of the tissues with polymorpho-nuclear leucocytes. The very thick mass of connective tissue which constituted the wall of the abscess showed upon its inner aspect some necrotic tissue. There were in it some areas of hyaline degeneration sharply marked off from the rest of the tissue. The alveolar walls in this neighborhood were all infiltrated with round cells and thickened. Both here and in the rest of the lung there was evidence of chronic bronchitis, and around some of the smaller bronchi peribronchitis. The alveoli were little

changed and the pleura was not thickened. Apart from the abscesses then there was no evidence of inflammation, except of the bronchi. There was no hepatization of the lung.

Jan. 22, 1902, rabbit No. 511, weight 225 grammes, was inoculated intrathoracically with one c. c. of an emulsion of the lungs received from Dr. Foster. This animal showed no symptoms up to April 8, 1902, when it was used for another purpose.

Jan. 22, 1902, rabbit No. 512, weight 1,525 grammes, was inoculated intravenously in the external ear vein with 1 c.c. of an emulsion of the lung received from Dr. Foster. The animal was found dead on the morning of Feb. 8, 1902. At autopsy no gross lesions were found. Direct coverslip preparations in cultures from the various organs showed no bacteria.

It would appear from the above examination that the disease at least of the animal from which the specimens were received in the laboratory of this board was not contagious pleuropneumonia.

Infectious bronchopneumonia—*Zumbro Heights, Hennepin County.*—Oct. 2, 1902, Dr. Chas. E. Cotton brought to the laboratory a portion of lung, wrapped in a newspaper, and four test tubes, each containing a small amount of broth, and all unlabeled. Dr. Cotton said he had that day killed and made an autopsy on a calf, the property of Mr. L. of Zumbro Heights. The calf had been ailing for some time and at the time of killing showed only the lesions of a simple bronchopneumonia. The cultures had been made from blood, lung, spleen and liver, but since none of them were labeled it was impossible to distinguish the sources. Fresh cultures were made from the lung, which had been cut into in several places, and second cultures were made from the original broth cultures. All were placed in the incubator the same evening received. After 18 hours incubation cultures from the lung showed many diplococci and large spore-bearing bacilli. From each of the four tubes above noted (that is, from blood, lung, liver and spleen), many diplococci, staphylococci, *B. coli communis* and a small spore-bearing bacilli were obtained. Since the material had been so contaminated in the collection it was impossible to assign any etiological significance to any of the organisms. It is worthy of note, however, that only diplococci and large spore-bearing bacilli—evidently putrefactive—were obtained from the lung.

Mr. L. was advised to disinfect the quarters where the animals had been kept, on the possibility that the disease may have been an infectious pneumonia. He did so and the outbreak ceased.

Infectious Ophthalmia—*Near Walnut Grove, Lyon County, Minn.*—Aug. 30, 1901, Dr. Wilson visited the pasture of Mr. D. and Mr. S., near Walnut Grove, and collected specimens from the eyes of two head of cattle. There were about 600 head of cattle in the pasture. The owners thought that about 30 had been affected with an eye disease, but only two marked cases of blindness could be found in the herd at the time. Several of the animals had apparently recovered. The disease was apparently an infectious ophthalmia. Cultures were taken from the eyes of a black steer and a red cow. These were sown in plain broth and on serum and plain agar. After 48 hours in the incubator only staphylococci developed in broth and on serum from the eyes of the black steer. Similar cultures similarly grown from the eyes of the red cow developed staphylococci and streptococci in broth and a few scattered colonies on serum. The staphylococci in both cases on subsequent cultures proved to be staphylococcus pyogenes aureus. The streptococci failed to grow in second generation.

The convalescent stage of the disease, the limited number of animals examined, together with the apparent nonspecificity of the recovered organisms, furnished insufficient data from which to draw conclusions.

Infectious Ophthalmia—*Anoka County.*—Nov. 13, 1901. Drs. Brimhall and Wilson visited the farm of Mr. P., 23 miles north of Minneapolis, in Anoka County, and took cultures from the eyes of 19 calves, all of which, with a number of others, were exhibiting symptoms of an acute, apparently infectious and in most cases ulcerative ophthalmia of one or both eyes. The animals were in a herd of 50 or 60 spring calves and yearlings, almost all of which were or had been affected. They were in a run down condition of health, having been fed since failure of pasture on wild grass hay. They had had very poor care in general, the owner being absent and only careless and lazy attendants in charge. The animals were caught and a sterile cotton swab rubbed over the surface of the cornea or into the ulcer if present. This was then inoculated directly in the surface of Löffler's blood serum in 10 instances and into plain broth in nine.

A rather small diplococcus resembling in morphology gonococcus, was present in all of the 19 cultures. In the nine broth cultures, short chains of cocci in pairs of the size and general appearance of the diplococci already noted were also present. These were not

seen in any of the serum cultures. They were probably the outgrowth of the diplococci as developed in broth, and could not be seen in cultures on solid media. In five of the nine broth cultures and in six of the ten serum cultures, a rather large staphylococcus was present. In six of the nine broth cultures, short, belted, bacilli or elongated diplococci were present. None were seen in any of the cultures or serum. In two of the broth cultures chains occurred of apparently these same bacilli. No such chains were found in any of the serum cultures. In one broth and in one serum culture, a rather short, slender, evenly staining bacillus with rounded ends was present. It did not appear in any of the other cultures.

It would appear from the above that the only organism constantly present was the diplococcus first described, with its possible variety, the streptococcus, described under broth cultures. Pressure of other work and lack of stabling accommodation for cattle prevented the immediate further examination of these cultures.

Mycotic Stomatitis—*Highmore, S. D.*—Feb. 11, 1903, Dr. Brimhall went to Highmore, S. D., to assist the authorities of that state in investigating an outbreak of disease of cattle which very much resembled foot and mouth disease.

About Christmas, 1902, one of these animals, which had previously been healthy (they all having been in quite good condition when brought in from the range some weeks before) became sick and died. The only symptoms observed were sore spots on the mucous membrane of the mouth and about the teats.

After the death of this animal and prior to Feb. 3, 1903, 10 other animals of the same herd died. In the meantime they had been running to water down a lane past the farm of Mr. B., whose cattle also went to water with them. On February 1st the herd of Mr. A. was separated from that of his neighbor and thereafter kept in a small enclosure away from all of the cattle. At the time of Dr. Brimhall's visit, February 12, 18 of the animals had died, a mortality of 37½ per cent. The owner thought that all the rest of the herd had had the disease in a mild form. None of the animals were showing any symptoms, except about eight, and these showed only small ulcers about the upper lip and dental pad. These were very irregular in form and some of the same animals had scabs upon the ends of the teats, and in one case there was an ulcer which was covered by a small scab upon the posterior part of the udder. There was also one other cow which had apparently recovered from

the disease which showed scars on the teats, indicating that at some previous time they had been covered with sores.

On autopsy the animal from which the specimens were received showed the skin red about the right hind ankle (perhaps frost bite?). A few small collapsed areas in the anterior lobes of the lungs and also quite a number of well defined small hæmorrhagic areas in the right anterior lobe were present.

These areas were long and narrow, indicating the involvement of several lobules. On the surface of the breast bone and in the muscles of the chest were hæmorrhagic areas. Hæmorrhagic areas were also found on the spleen and one on the omentum about the size of a quarter of a dollar. Aside from this the other organs appeared healthy.

Although the disease resembled in many respects true foot and mouth disease, Dr. Brimhall was satisfied that it was not the same disease, but probably the disease described by J. W. Conway of Ohio and various other observers as mycotic stomatitis.

Feb. 14, 1903, Dr. Brimhall brought to the laboratory cultures in broth and a swab from the cow noted in the above autopsy. These cultures had been collected without proper apparatus, sterilization of the organ having been made by a burning pledget of cotton soaked in alcohol.

Cultures were made from lung, heart and spleen. After 48 hours in the incubator cultures developed as follows:

From the lung, short colon-like bacilli, some of which were almost diplococcoid. A number of sub-cultures were made from these cultures to determine if possible the presence of *B. bovisepticus.* Nothing except motile (colon) bacilli were obtained.

Heart's blood, no growth.

Spleen, long, slender bacilli and large thick, spore-bearing bacilli (both probably contaminations) and *B. coli communis.*

From the liver, *B. coli communis.*

Cultures were also brought to the laboratory at the same time by Dr. Brimhall from case No. 2, noted above. These had been made from the udder and teat of a living cow.

After 48 hours in the incubator cultures from both teat and udder showed only *staphylococcus pyogenes albus.*

Coal Tar (?) Poisoning—*East Chain Township, Martin Co.*—April 29, 1902, Dr. Annand visited the farm of Mr. S. C. McR. of Martin Co., Minn., to investigate a report of supposed hæmorrhagic

septicæmia. April 22, the owner had made a watering trough, covering the boards with what he supposed to be coal tar (i. e. material in a tin can found by the owner when he first moved to the place). April 23 all of the stock (eight or 10), but one cow and the calves refused feed. Most of them showed some general weakness. The calves were taking milk and did not sicken. The owner gave all of the affected animals milk and linseed oil. One animal died on April 25 and another on April 28. On this last animal Dr. Annand made an autopsy. Decomposition had set in to some extent and a post-mortem examination was unsatisfactory. The stomach was inflamed and there was a slight congestion of the bowels. At the base of the brain was a hæmorrhage with surrounding congestion. From the condition of the stomach and the history of this ailment a provisional diagnosis of carbolic acid poisoning was made. Two portions of the spinal cord, together with pieces of lung, kidney, spleen and heart were removed and placed in formalin solution. A swab culture from the base of the brain was also taken.

On receipt in the laboratory, cultures from base of the brain were inoculated into fresh material. Only *B. coli communis* was present. Owing to the fact that the tissues had been placed in formaldehyde, it was impossible to make any cultures therefrom.

New Richland, Waseca Co.—(*Cattle*)—Dec. 8, 1902, there was received in the laboratory a small portion of tissue accompanied by the following letter:

"This specimen of lung is from an eight months old calf. Please examine and inform me if it is dangerous to use the flesh, and oblige,

E. E. VER PLANK."

Owing to the condition of the specimen when it was received in the laboratory no satisfactory examination was possible.

Eczema—*St. Cloud, Stearns Co.*—Feb. 7, 1903, during an investigation of swamp fever on the farm of Mr. H., 12 miles north of St. Cloud, Minn., the attention of Drs. Brimhall and Wesbrook was called to a condition present in a number of cattle on the place. Various areas of the bodies of the animals were covered with moist patches which resembled eczema. Close examination of the skin showed the presence of minute papillæ which, when scraped, left a bleeding surface. Later in the disease apparently the hair became loosened and could be readily pulled out, having at its roots a dry whitish material. The skin was thickened and involved over such bare areas.

A number of thoroughbred cattle were affected, amongst them a small male Shorthorn calf not quite one month old. This animal had the disease in its earliest stages and the hair was not loosened. Particurarly affected was the skin under the throat and later along the belly. From underneath the throat after clipping off the hair and scraping the surface with the blade of a scissors, a small piece of skin was snipped out and placed in Zenker's fluid for microscopic examination.

Some of the hair was forcibly pulled out with the material at its roots and with some of the scrapings of the surface of the skin were placed in a small coverslip box to be examined later.

Smears were made from the surface of the papillæ, whose edges had been scraped off for microscopic examination and a culture by means of a sterile swab was made from the area from which the skin had been removed with the scissors. This culture included the exudate from bleeding surface and scrapings of the cut edges.

Cultures gave a yellow and a white *staphylococcus* and a short thick, non-motile bacillus that grows with a transparent growth on agar, reddens dextrose and maltose agar and blues lactose and saccharose. No change in litmus milk. No protozoa were found on hair or scabs.

Streptococcus Infection—*Faribault, Rice Co.*—On Feb. 19, 1903, there was received in the laboratory a cow's foot and ankle from the School for Feeble Minded, Faribault, Minn., with the following history:

"She had been having this trouble for about nine weeks. First started on the upper margin of the cleft of the hoof. Later the leg was lanced. Cow lost strength rapidly and became greatly emaciated. One other cow showing same symptoms; that is, as far as lameness is concerned."

On February 20th this specimen was opened by Dr. Brimhall, exposing the sesamoid sheath, in which was a great quantity of purulent matter. A portion of the tendon was necrosed.

Cultures were taken from area close to the pus cavity and also from the pus itself.

Direct coverslip preparations stained with esosin and methylene blue showed many *strepto*-and *staphylococci* and small bacilli. Cultures in broth, on serum and on agar after 24 hours in the incubator showed *streptococci*, *staphylococci* and small motile bacilli, which on subsequent cultures proved to be *B. coli communis.*

MENINGITIS IN HORSES, CATTLE, SHEEP AND SWINE.

Introductory.—Meningitis in horses, cattle, sheep and swine has occurred in Minnesota in small isolated outbreaks a number of times during the last few years. The first outbreak investigated in detail by this board was that reported in the Biennial Report for 1898, page 180, in which an organism not distinguishable from *diplococcus intracelluiaris meningitidis, Weichselbaum*, was isolated from the central nervous system of a cow, the fifth to die on a farm near Rosemount. In the Biennial Report for 1899-1900, page 459, two other outbreaks in cattle were reported; one at the State Experiment Station, and the other near Lake Minnetonka. Both of these were shown to be due to *diplococcus pneumoniæ.* In the same report, pages 285 and 460, is recorded the history of an outbreak of meningitis in horses near Herman. These were typical cases (seven in all) in history, symptoms and lesions. The last inoculation experiment from this outbreak reported in the previous Biennial Report (see page 462, horse No. 3) was incomplete at the time of the writing of the report. The first portion of this experiment is herewith repeated in connection with the final results of the experiment.

Horse No. 3. Very old. Tested with mallein, May 25, 1900; no reaction. Inoculated into left carotid artery May 29th with 3.5 c.c. of twenty-four and forty-eight-hour broth culture, emulsified with twenty-four and forty-eight-hour serum culture of diplococcus of *Herman meningitis stock*, second culture from brain of horse No. 2.

Animal showed no symptoms up to and including June 15th, and remained well (no rise of temperature).

June 15, 1900, at 2:30 p. m., animal inoculated subcutaneously just back of left shoulder with 500 c.c. fourty-eight-hour plain broth culture of diplococcus from *Herman meningitis stock* "original." (Not passed through horse No. 2.) Also subcutaneously behind left shoulder with 500 c.c. forty-eight-hour plain broth culture of diplococcus from *Herman meningitis stock;* third culture from horse No. 2.

Friday, June 22nd, specimen of pus collected from abscess on left shoulder. Abscess had opened itself within the previous hour. Direct coverslip preparations showed abundant diplococci. No other micro-organisms observed.

Cultures on Löffler's serum and on plain broth after twenty-four hours in incubator showed only diplococci present."

Nothing further occurred until Sunday morning, July 8, 1900, when horse noticed by attendant to be apparently "off his feed." Sunday evening was down, making frequent efforts to rise, being apparently weak in his back. Was able to rise on his fore feet, but could proceed no farther toward getting up. Horse tried to eat while down. Temperature taken Tuesday, July 10th, at 3 p. m., subnormal. Animal found dead morning of Wednesday, July 11th, still warm.

Autopsy at 9 a. m. on the same day. Congestion of vessels, particularly the minute capillaries of the pia. No marked exudate in brain. Similar congestion in vessels of cord in cervical and lumbar regions. The left lung showed numerous small nodules, some of which contained a cheesy deposit surrounded by a tough capsule. One old scar and one nodule on the nasal septem. No ulcers.

Direct coverslip and serum and broth cultures were made from the meninges of (a) the superior surface of the cerebrum; (b) inferior surface of the temporal lobes; (c) cervical cord; (d) lumbar cord. Cultures also were taken from one nodule in lung.

Direct Coverslip Preparations.

(a) From superior surface of cerebrum showed no bacteria.

(b) From base of brain, a few diplococci.

(c) From cervical cord, many diplococci.

(d) From lumbar cord, few diplococci.

(e) From various nodules in lung, no bacteria.

Cultural Examinations.

(a) From superior surface of cerebrum, no growth either in broth or on serum.

(b) From base of brain, in broth fair growth; on serum, about twenty colonies of diplococci.

(c) From cervical cord, in broth, good growth; on serum, numerous isolated colonies, all diplococci.

(d) From lumbar cord, in broth, fair growth; on serum, about twenty colonies of diplococci.

(e) From nodule in lung, in broth, very abundant growth of small unevenly staining bacilli, probably *B. coli communis.*

The results of these two inoculations (see the above and horse No. 2, page 462, Biennial Report for 1899-1900) would seem to prove

beyond a doubt the ætiological relationship of *diplococcus pneumoniæ* to the disease.

The following is a detailed statement of the examinations of cases of meningitis made from Jan. 1, 1901, to April 23, 1903:

Osakis, Douglas County (Horses)—Nov. 28, 1900, Dr. Brimhall visited the farm of Mr. F. P., near Osakis, Douglas County, to investigate the cause of death in horses. Mr. P. had lost four horses in a little over a week, and a fifth had been sick, but recovered. Those which died were sick from twenty-four to thirty-six hours. As they had all been dead several days, post-mortem examinations were out of the question, but from the description given by the owner, Dr. Brimhall felt certain that the cause of death was due to cerebro-spinal meningitis.

Another man living about ten miles north of Osakis had lost five horses with what he thought was the same trouble, but they had been dying one at a time for a period of three months. The diagnosis was very doubtful.

Torah, Stearns County (Cattle)—On Jan. 12, 1901, there was received from H. Bouman, M. D., Torah, Minn., the head of a cow, the fifth to die on a farm near Torah. All the cattle except one were yearlings. They had been fed with corn stalks and unhusked corn. The symptoms noted were about the same in all animals. They refused to eat, showed great prostration and were unable to rise after the first day. The eyes were inflamed and swollen, with considerable discharge from both eyes and nose. There seemed to be marked fever, though temperatures were not taken. One died after two days' illness, three after three days' illness and one after two days' illness.

When the head was received in the laboratory it was in good condition and on opening the skull well marked meningitis was present. Diplococcus pneumoniæ was found abundantly in cover-slip preparations and unmixed with other organisms in cultures.

Chanhassen Township, Carver County (Cattle)—Jan. 20, 1901, Dr. Brimhall visited the farm of Mr. A. H., Chanhassen Township, Carver County, to investigate the cause of death of Mr. H.'s cattle. Mr. H. had originally sixteen cows and two calves. Five of the cows had died after very short periods of illness, during which they showed rapidly ascending paralysis. One cow which had been sick and paralyzed so that she was unable to get on her feet had so far recovered at the time of Dr. Brimhall's visit that she was able to stand, though with difficulty. The owner gave a very clear description of the symptoms shown by cattle and Dr. Brimhall diagnosed

the disease as cerebro-spinal meningitis. Isolation of the healthy cattle and disinfection of the stable was recommended. No further trouble from the disease arose.

Faribault, Rice County (Cattle)—June 21, 1901, Drs. Brimhall and Wilson, in company with Dr. L. Hay of Faribault, visited the farm of Mr. S., nine miles northwest of Faribault. About the first of April Mr. S. had lost a two-months'-old calf, which at that time was being fed on milk from the creamery. About a month later he lost a six-months'-old steer, and between that time and June 21 six other cattle, eight in all, had died. There were twenty-one animals originally in the herd. About half of them were cows and the remainder yearlings or six-months'-old steers and heifers. Five of the young cattle and three cows had already died. The owner said that all the animals exhibited practically the same symptoms. They first became somewhat stupid, had a wild staring look in the eyes and seemed slightly stiff in the back. After a short time they all became crazy, and rushed about the barnyard and attempted to bunt the other cattle and the owner. The posterior portion of the body then became paralyzed. Throughout the disease all the animals made frequent straining attempts to pass fæces; all had diarrhœa, which in most cases was bloody. The animals died in from one to four days after showing symptoms of the disease. The local "cow doctor" examined some of the sick animals and pronounced the disease diphtheria. About June 15, Dr. Hay saw one of the sick animals, which was almost dead at the time. He killed it and made an autopsy. He did not skin the carcass nor examine the central nervous system, but otherwise the autopsy was complete. No lesions were found except a slight degree of entero-colitis. June 21 a small red cow had been sick for two days, but the owner thought she was a little improved over what she had been the previous day. She presented a staring condition of the eyes with stiffness and slight incoordination of the hind legs. Her temperature was 102.5°. The owner was instructed to ship the head and neck, in case the cow died, packed in ice to the laboratory.

June 25, at 9 a. m., there was received in the laboratory a head of the small red cow described above. An examination was made at once by Drs. Brimhall and Wilson. On removing the skin a few small hæmorrhages were found in the subcutaneous tissue on sides and back of the neck. None were found on the under side of the neck. These may have been due to bruises received from the rope or chain with which the animal had been tied. The pharynx was markedly inflamed. On opening the skull the vessels of the pia

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were found engorged with blood and considerable pus was present in the sulci, especially near the base of the cerebrum. (All of the tissues were very nicely preserved; large cakes of ice were still present in the barrel containing the specimen when it was received in the laboratory.)

Direct coverslip preparations and broth and serum cultures were made from the hæmorrhagic subcutaneous areas and from various portions of the meninges. The upper two inches of the spinal cord divided into one-half inch segments with portions of the cortex of the left cerebrum were preserved in alcohol and formalin for histological examination. A portion of the medulla aseptically removed was used for inoculating rabbits Nos. 436 and 437. The direct coverslip preparations were stained with eosin and methylene blue. Careful search of all of them showed a few pairs of diplococci in those from the meninges. Cultures were examined after twenty-four hours in the incubator. Two broth and two serum cultures from the subcutaneous hæmorrhages developed no bacteria. Of the eight cultures from the various portions of the meninges, five—three broth and two serum—gave a growth of small, slowly growing diplococcus, which occasionally showed chains of four to eight individuals. No other bacteria were present in any of the cultures. Second cultures from the original ones from the meninges were sown heavily in the broth and on serum, and after twenty-four hours in the incubator were used for inoculation of rabbits Nos. 442 and 443, and of guinea pigs Nos. 441 and 442.

Rabbits Nos. 436 and 437 inoculated subdurally with an emulsion of the medulla of the cow noted above, died after six and eighteen days respectively, having shown symptoms of meningitis, viz., excitement, holding of head to one side, stupor and death. The symptoms had begun thirty-six hours after the inoculation. At autopsy no lesions were present except in the meninges, where the vessels were intensely congested, and some of the sulci near the base of the cerebrum contained a small amount of pus. Direct coverslip preparations and cultures in broth and on serum showed *diplococcus pneumoniæ*, apparently unmixed with other organisms.

Rabbit No. 442 was inoculated in the left subdural space with 0.2 c.c. of the emulsion of a twenty-four-hour broth with a twenty-four-hour Löffler's serum culture of the diplococcus, second from the original from the meninges of the cow, June 27, 1901. Only July 9, this animal began to show bilateral weakness of the muscles of the fore part of the body. There was no retraction of the head. The animal was found dead on July 11. At autopsy the meningeal

vessels were found intensely congested, especially at the base of the brain. There was an increased amount of cerebro-spinal fluid. One small hepatized area was found in the right lung. The spleen was extremely small and of dark color. Direct coverslip preparations from the meninges showed diplococci. From the heart's blood no bacteria. Cultures in broth and on Löffler's serum showed many diplococci from the meninges. Those from the heart's blood gave no growth.

Rabbit No. 443 was inoculated intraperitoneally, June 27, 1901, with 1.5 c.c. of an emulsion of a twenty-four-hour broth with a twenty-four-hour serum culture of the diplococcus, second from original from meninges of cow, also 0.5 c.c. of the same material was injected into the right nostril. July 10, the first symptoms of meningitis appeared similar to those noted in rabbit 442. The animal died July 12. Autopsy showed intense congestion in the vessels and meninges of the skull. Congestion was most marked at the base of the brain. There was considerable increase of fluid in the ventricles. The spleen was almost completely atrophied. Direct coverslip preparations from the meninges showed a few diplococci from the heart's blood; no bacteria. Cultures in the broth and on serum from the meninges showed a slight growth of diplococci. Those from the heart's blood no growth.

Guinea pig No. 441 was inoculated June 27, 1901, in the left subdural space with 0.2 c.c. of the same material as that used in the inoculating of rabbits Nos. 444 and 443. The animal showed no symptoms at any time during the next succeeding six months, when it was used for another purpose.

Guinea pig No. 442 was inoculated June 27, 1901, intraperitoneally with 0.5 c.c. of the emulsion of the same material as that used for inoculating rabbits Nos. 442 and 443. The animal was also given 0.5 c.c. of the same material by high injection into the right nostril. This animal showed no symptoms during the ensuing six months, and it was then used for another purpose.

These several inoculations were undertaken to determine the possible presence of rabies virus. It would appear however that the early onset of the symptoms and death in rabbits 436 and 437; the production and symptoms of meningitis without posterior paralysis or retraction of the head by subdural and intraperitoneal injection of pure cultures of the diplococcus in rabbits 442 and 443; and the failure to produce any symptoms in guinea pigs Nos. 441 and 442 after similar inoculations with the same material; together with the uniform production of the lesions of meningitis and the

multiplication of diplococcus pneumoniæ within the tissues of inoculated rabbits, would warrant the conclusion that the disease in the cow was meningitis due to *diplococcus pneumoniæ*, and unmixed with the virus of rabies or with other bacteria. This case would seem to be an important one owing to the difficulty sometimes experienced in distinguishing clinically between rabies and meningitis due to *diplococcus pneumoniæ*.

Lucas Township, Lyon County (Cattle)—Sept. 21, 1901, Drs. Annand and Wilson visited the farm of Mr. J. D. S., of Lucas Township, Lyon County, seven miles south of Cottonwood, Minn., to investigate an outbreak of an obscure disease. Mr. S. gave the following description of the cases: During the summer the cattle had been divided into two herds. A portion of them was kept on the farm on high rolling ground sown with rape. The other portion was in a large public grass pasture near Tracy. July 28, 1901, a cow on the home place was noticed to be sick, and died within twenty-four hours. Three weeks later or about August 18, a calf became sick and when apparently about to die on same day was killed. Three weeks after this, or about December 8, another cow became sick and died within twenty-four hours. One week later, or September 16, four young cattle, three of which had been brought back ten days previously from the pasture near Tracy, all became sick. Two of these at the time of the visit of Doctors Annand and Wilson were apparently better. The third was becoming slightly worse and the fourth was almost dead. The symptoms as described by the owner were refusal of food, trembling, bellowing, "drooling" from the mouth and an entire inability to swallow either food or water. One of the animals had been apparently blind. No bloody discharges were observed from any organs of any of the animals. The two yearlings which were apparently on the road to recovery seemed somewhat emaciated and had some difficulty in swallowing, but were able to chew their cud. The third spent most of the time at the watering tank with his nose immersed in the water and made a "champing" motion with his jaws as though attempting to get the water into his mouth. It seemed entirely unable to swallow. It was very much emaciated, the eyes being notably sunken. The fourth animal was down and apparently unable to rise. It was breathing in a jerky manner as though in pain. It made no attempt to swallow, though it frequently champed its jaws. There was considerable drooling from the mouth. (The temperature of all the animals examined was normal.) The animal was killed by a blow on the head and an autopsy made at once. Careful examination of

the tongue and throat regions revealed no lesions except a slight congestion in the posterior nares and throat. One-half the animal's body as well as the whole of the neck was skinned, but no hæmorrhagic areas were found. A small slightly hæmorrhagic spot was found on the wall of the third stomach. The spleen was shrunken. A careful examination was made of all of the internal organs, and no other lesions were noted except that both kidneys were on the right side of the abdomen, an apparent anatomical anomaly. The condition of the central nervous system was somewhat disguised by the method of killing—blow on head—but so far as could be determined no evidence of meningitis was present. Direct coverslip preparations and cultures were collected from blood of the carotid artery, from lung, pericardial fluid, heart's blood, spleen, liver, and meninges.

One of the two serum cultures from the blood of the carotid artery developed one colony of streptococcus pyogenes aureus. The other culture and one of the two broth cultures remained sterile. The colony which developed may have come from the knife with which the artery was severed. The only other micro-organism found in any of the cultures was a large oval spore-bearing bacillus which grew at room temperature on the surface of one of the two serum cultures made from the liver. Another serum culture from the same source showed no bacteria. These cultures were made on the open prairie with the wind blowing a gale so severe that the alcohol blast lamp was frequently extinguished. No bacteria of any kind were found in any of the direct coverslip preparations.

Oct. 5, 1901, Drs. Brimhall and Wilson again visited the farm of Mr. J. D. S., and examined several cattle sick of the disease described above. No animals were dead and it was impossible to secure any for the purpose of autopsy. Careful study was made of the clinical symptoms and despite the previous negative bacteriological findings it was thought that the disease was meningitis.

The history of the onset of the disease and the symptoms in these cases point to infectious meningitis. The normal temperature and the apparent absence of specific bacteria from the tissues of the sick animal, however, make the diagnosis of an infectious meningitis doubtful.

Crow Lake Township, Stearns County (Cattle)—Feb. 26, 1902, Dr. Brimhall investigated an outbreak of cattle disease in Crow Lake Township, Stearns County, near Belgrade. Cattle on several different farms had been dying of the disease, which presented some obscure symptoms, but resembling those described in the preceding

outbreak. No cattle were very sick at the time of Dr. Brimhall's visit and none could be obtained for autopsy. From the owner's description of the symptoms and from the symptoms seen by him, Dr. Brimhall was of the opinion that the cattle had been suffering from meningitis. Disinfection of stables, etc., was recommended and no more cases were reported.

Barden Township, Carver County (Swine)—Jan. 9, 1903, Mr. C. P. C. of Barden, Carver County, shipped to the laboratory three pigs of which he gave the following history: "The original litter contained nine pigs. They were born about Sept. 1, 1902, and had thriven well all the season until about the middle of December, when one was noticed having some trouble, which seemed like fits, coming on usually after they first came to the trough in the morning. They would get up to the trough and start to eat and then suddenly back up and sometimes would fall flat and breathe very hard with a grunting noise. This would last for an hour or more and then they would apparently be as well as ever. These spells became more frequent and longer in duration. The pigs died after about two weeks' sickness. Seven died, two were shipped to the laboratory along with a third healthy pig from another litter."

After arriving at the Laboratory of Animal Research the two sick ones showed spells similar to attacks of epilepsy, the smaller of the two having it much more severely. On this pig (No. 28 laboratory series), the following observations were made: The first attack came on the day after arrival and soon after having drunk water. The pig "backed up" and stood very stiffly. He made a peculiar grunting noise with each short, gasping respiration. This was quite typical of all the attacks, but after an attack which occurred on the 31st he breathed freely, but continued to show the short, grunting respiration. Animal was somewhat stiff all the time. Later the respiration seemed to improve, but the hind legs became weak and sufficiently paralyzed so as to prevent the animal from standing up. Temperatures were taken as follows: January 12, 103.8°; January 14, 103°; January 19, 104.3°. The pig was killed January 20 for the purpose of autopsy. No lesions were found except a small hæmorrhage in larynx at the side just above the cricoid cartilage. The pia at the base of the medulla was somewhat hæmorrhagic. Cultures from the lumbar cord and kidney showed no growth. Those from the medulla, liver, heart's blood showed diplococci; from the spleen a large nonmotile bacillus (probably a contamination).

Rabbits Nos. 664 and 684 were inoculated intravenously and subdurally respectively, with cultures of the diplococcus from this case, but showed no symptoms during the ensuing two months, after which time they were used for other inoculations.

The other sick pig, No. 30, laboratory series, presented much the same symptoms as its companion. January 12 its temperature was 104.8°; January 19, 104.6°. Died January 24. Autopsy showed no gross lesions except marked injection of the mesenteric vessels, a few collapsed areas in one lung and some evidence of meningitis. Cultures from the heart's blood showed no growth; from the kidney, liver and spleen streptococci in short chains; and from the meninges diplococci and streptococci.

From the facts above given it would seem that both pigs were suffering from infection of *diplococcus pneumoniæ* with a secondary infection of streptococci in one of the animals. The low virulence of the organism may account for the somewhat chronic nature of the disease. The cases are, however, too few to warrant the drawing of any sweeping conclusions.

Hayward Township, Freeborn County (Horses)—Jan. 8, 1903, Dr. Annand visited the farm of Mr. G. P. T., three miles east of Glenville, Minn., Hayward Township, Freeborn County, to investigate a disease of horses.

Beginning about three weeks prior to the onset of the first symptoms Mr. T. had fed his horses on ensilage. On opening the silo some of the material from the top had been found considerably decomposed. This had been forked off and scattered about the barnyard. When the horses were first put on the fresh ensilage they refused it, but after a little time began to eat it quite freely.

According to the history obtained from the owner, "one mare was noticed not right at 4 p. m. Jan. 2, 1903. First symptoms noticed were slobbering; about three hours later uneasiness in the stall; at 8 p. m. noticed that animal had lost power of deglutition. At the same hour noticed the animal trembling some. At 9 p. m. started to sweat, went down and unable to rise sometime between 10 and 11 p. m. When seen, paralyzed, tongue extended and the animal went from bad to worse until she died at 3 p. m., Jan. 3, 1903. This animal was seven years old and weighed 1,800 pounds. No post-mortem made."

The horse on which Dr. Annand held a post-mortem was noticed to be sick on Monday evening, January 5, and followed very much the same course as the other one except that it was not quite so

aggravated, and died about 8 o'clock p. m., Jan. 7, 1903, after forty-eight hours' sickness.

Post-mortem made at 3 p. m., January 8. On cutting the animal open the first thing noticed was hydro-thorax and some fluid in the peritoneal cavity. The right lung was somewhat congested; the heart on one side seemed to be somewhat inflamed, but could not determine positively. It might have been hypostatic. The small intestines were somewhat injected and along the course of the mesenteric artery of small intestines there were bloody deposits. The liver was somewhat dark in color and quite easily torn. On opening up kidneys pustular matter was found in the pelvis. On removing the head a great amount of serum escaped and about the cord the meninges were more or less injected. On removing a portion of the spine in the sacro-lumbar region the vessels of the cord and its coverings were found much injected.

A portion of the lung, heart-wall, spleen, liver, kidney and spinal cord and the whole of the brain enclosed in the skull were brought to the laboratory in a frozen condition. Specimens were examined the morning of Jan. 10, 1903. The lungs showed small collapsed areas; the heart-wall showed a hæmorrhagic portion $1\frac{1}{2}$x2 inches, very dark in color and evidently a lesion present before death. The cortex of the kidney was much congested. The meninges of the spinal cord and brain were congested but showed no pus.

Portions of tissue from each of the organs were preserved in 10 per cent formaldehyde and in 96 per cent alcohol. Cultures were made in broth and on serum from each of the organs, including both the meninges and white matter of the brain. After forty-eight hours in the incubator a growth was present in and on all of the cultures, excepting those from the brain substance which showed no growth on either medium.

After careful picking of colonies and sowing out on various media, the following organisms were isolated from the different sources:

Lungs.

(1) Streptococci in long chains; very numerous.

(2) Diplococci, apparently *diplococcus pneumoniæ.*

(3) *B. coli communis.*

Heart Wall. Streptococci only; long chains.

Spleen.

(1) Streptococci in long chains.

(2) Staphylococcus (albus?).

Liver. Streptococci.

Kidney. Streptococci.

Meninges of spinal cord. Streptococci, diplococci and large spore-bearing (putrefactive?) bacilli.

Meninges of brain.

(1) Streptococci and diplococci.

(2) Staphylococcus albus.

Brain substance. No growth.

At the time of Dr. Annand's visit another horse was sick. Temperature was 100.5°, respiration 22, pulse 58, mucuous membrane of eyes was somewhat injected.

Jan. 28, 1903, Drs. Brimhall and Wilson visited the farm of Mr. G. P. T. again. On arrival a seven-year-old gray horse, No. 29, Laboratory series, which had been sick for ten days was found down on its right side in the barn. The animal began ailing on January 11 and went down on January 18. The owner did not think until the horse went down that it was suffering from the same disease of which the others died. During this time Mr. T. had fed it gruel, milk, etc., from a bottle, it being unable to swallow coarse food. The animal was apparently unable to make even an effort to rise, though it was able to freely move both front and hind legs. It could raise its nose but not its head. Sensation seemed to be entirely absent over the posterior extremities. Temperature of this animal was 105.2° at 8:30 a. m., January 22nd. This was the fourth animal out of five which Mr. T. had lost, the second being the one from which specimens were collected by Dr. Annand, Jan. 8. 1903.

The third was the horse noted by Dr. Annand as becoming sick on January 8, and concerning which data was to be supplied by Mr. T. The animal died January 12. Shortly after Dr. Annand's visit two other horses were hired from a neighbor to do the work of the farm, but were kept in a shed apart from that in which Mr. T.'s horses had been sick. However, a door opened from this shed into the barn in which the sick horses had been kept.

Horse noted above was killed by bleeding, and an autopsy made at once. The throat, posterior pharynx and trachea were apparently normal. Lungs showed hypostatic congestion in the dependent portions, and a strip of consolidated tissue in the center of the anterior lobe about three inches long and one-half inch wide on the left side. Several areas of hæmorrhage from one-fourth to one inch in diameter were found under the endocardium. The spleen was small and rather dried than normal. The liver was apparently

fatty. The intestines and mesentery were apparently normal except for the presence of several aneurisms containing worms,—*strongulus armatus*—in the mesenteric arteries. The kidneys were apparently normal—except for a clot—extracapsular—about the right (lower) kidney. On opening the spinal cord at the cervical region a large amount of reddish colored serum escaped. The meninges of the brain and cord were congested, but showed no pus. Congestion was most intense about the pons and base of the cerebrum. In the lumbar region of the cord small flakes of yellowish exudate *(fibrin)* were found attached to the pia of the cord.

Direct coverslip preparations, cultures and tissues for histological examination were collected from the trachea, lung, heart, spleen, liver, right hock and meninges of brain and spinal cord in the cervical and lumbar regions.

Direct coverslip prepartions stained with eosin and methylene blue on examination showed bacteria, as follows:

Lung. Diplococci.

Heart's blood. Negative.

Spleen. Negative.

Liver. Negative.

Right hock. Negative.

Meninges of brain. Diplococci (lanceolate, encapsulated, Gram-staining, some intracellular and some extracellular.)

Cervical spinal cord. Ditto.

Lumbar spinal cord. Ditto.

Cultures in broth and on serum after incubation showed bacteria as follows:

Trachea. Numerous large and small bacilli; staphylococci. (No diplococci.)

Lung. Diplococci.

Heart's blood. Negative.

Spleen. A few streptococci.

Liver. Negative.

Right hock. Negative

Meninges of brain. Diplococci (lanceolate Gram-staining).

Meninges of cervical spinal cord. Diplococci (lanceolate Gram-staining).

Meninges of lumbar spinal cord. Diplococci (lanceolate, Gram-staining).

The diplococci isolated from the meninges of brain and spinal cord and from the lung gave a turbid growth in broth and after

twenty-four hours a slight precipitate. On agar, white isolated colonies about 0.5 mm. in diameter.

In and on litmus lactose and litmus dextrose agar colonies developed similar to those on plain agar. The acid reaction on these media was variable within narrow limits, but there was no formation of gas bubbles.

On serum the colonies were somewhat larger in diameter than on agar, pasty in appearance and of the color of the serum.

No visible change was produced in milk after eight days' growth in the incubator.

In gelatin stab cultures only a very faint growth took place along the needle track after eight days.

Rabbit 671 was inoculated intravenously with 0.3 c.c. of a broth culture, fifth generation of the diplococcus from this horse. Animal died after four days.

At autopsy many diplococci were found in the exudate from the meninges both within and outside of the leucocytes. One small focus of pus was present in the right lung. No other gross lesions were discoverable.

Rabbit No. 685 was inoculated February 28, in left subdural space with 0.2 c.c. with emulsion of the serum culture from this case. The animal began to exhibit symptoms of meningitis on second day after inoculation and died seven days later. Marked meningitis was present at autopsy and *diplococcus pneumoniæ* was recovered from the meninges.

There can be no doubt that these cases were *meningitis*, due to *diplococcus pneumoniæ*. The same train of symptoms has however been reported by Pearson* as being reproduced by him in horses by feeding with ensilage. Therefore, in order to determine whether the ensilage had anything to do with the direct production of the disease or with transmitting the organism to horses, the following experiments were conducted:

January 5 Mr. T. shipped to the laboratory in twenty-four sacks over one ton of the ensilage. Six of these sacks were filled with the half decomposed material described above, and the remaining eighteen sacks with good ensilage. The weather was cold at the time and the sacks were placed out doors, where they remained frozen for some time. They then thawed out and began to decompose and mould.

*Pearson. Journal of Comparative Medicine and Veterinary Archives, 1900, volume XXI., page 654.

Experimental horse No. 12, a large, old, thin, but healthy horse, was placed in a box stall at the Research Laboratory of the board and given ensilage as follows:

Jan. 30, 1903, began feeding on good ensilage. No other feed was allowed. Horse at first refused ensilage, but later ate it sparingly. After two sacks of the good ensilage had been given the decomposed ensilage was substituted on February 5. One sack of this had been eaten by the horse by February 9. The animal at this time, however, had lost so much flesh that he was again placed on the better ensilage and a little corn was added to it. The ensilage and grain were made into a mash part of the time and part of the time the ensilage was fed by itself in a moist condition. The animal was kept on this feed until March 13, or forty-three days in all. During this time his temperature was taken twice daily, as follows:

1903. Date. Jan.	Hour.	Temp.	1903. Date. Feb.	Hour.	Temp.	1903. Date. March.	Hour.	Temp.
30.	5:15 p. m.	100	19.	5:00 p. m.	100.2	8.	9:00 a. m.	98.2
31.	9:00 a. m.	99.8	20.	9:00 a. m.	100.4	8.	5:00 p. m.	98.8
Feb.			20.	5:00 p. m.	100.2	9.	9:00 a. m.	98.4
1.	11:00 a. m.	100	21.	9:00 a. m.	100	9.	5:00 p. m.	98.2
2.	10:00 a. m.	99.4	21.	5:00 p. m.	100.2	10.	9:00 a. m.	98.2
2.	4:30 p. m.	99.6	22.	9:00 a. m.	100.4	10.	5:00 p. m.	98.8
3.	9:00 a. m.	99.1	22.	5:00 p. m.	99.4	11.	9:00 a. m.	98.4
3.	4:00 p. m.	100	23.	9:00 a. m.	99.2	11.	5:00 p. m.	98.2
4.	9:00 a. m.	100.4	23.	5:00 p. m.	99.2	12.	9:00 a. m.	98.4
4.	5:00 p. m.	100	24.	9:00 a. m.	99	12.	5:00 p. m.	98.4
5.	11:15 a. m.	99.6	24.	5:00 p. m.	99.2	13.	9:00 a. m.	98.2
5.	5:30 p. m.	100.2	25.	9:00 a. m.	98.8	13.	5:00 p. m.	98.2
6.	9:00 a. m.	98.8	25.	5:00 p. m.	98.6	14.	9:00 a. m.	98.4
6.	5:00 p. m.	99.4	26.	9:00 a. m.	98.8	15.	10:00 a .m.	98.6
7.	11:00 a. m.	98.9	26.	5:00 p. m.	98.4	15.	5:00 p. m.	98.4
7.	5:00 p. m.	99.4	27.	9:00 a .m.	99	16.	9:00 a. m.	98.6
8.	10:25 a. m.	99.4	27.	5:00 p. m.	98.6	16.	5:00 p. m.	98.2
9.	10:30 a. m.	99	28.	9:05 a. m.	98.6	17.	9:00 a. m.	98.8
9.	4:30 p. m.	99.4	28.	5:00 p. m.	98.8	17.	5:00 p. m.	98.4
10.	9:00 a. m.	99.6	March.			18.	9:00 a. m.	98.6
10.	4:30 p. m.	98.6	1.	9:15 a. m.	98.4	18.	5:00 p. m.	98.4
11.	10:30 a. m.	98.6	1.	5:00 p. m.	98.2	19.	9:00 a. m.	99.4
11.	4:30 p. m.	99	2.	9:30 a. m.	98.2	19.	5:00 p. m.	99
12.	10:25 a. m.	99	2.	5:00 p. m.	98	20.	9:00 a. .m	99.2
13.	10:30 a. m.	99.6	3.	9:00 a. m.	98.4	20.	5:00 p. m.	98.8
13.	4:45 p. m.	101.4	3.	5:00 p. m.	99.2	21.	9:00 a. m.	98.4
14.	4:15 p. m.	100.2	4.	9:00 a. m.	99	21.	5:00 p. m.	98.6
15.	10:00 a. m.	99	4.	5:00 p. m.	99	22.	9:30 a. m.	98.4
16.	10:00 a. m.	98	5.	9:00 a. m.	98.6	22.	5:00 p. m.	98.6
16.	4:45 p. m.	98.6	5.	5:00 p. m.	98.8	23.	9:00 a. m.	98.8
17.	10:00 a .m.	98.8	6.	9:00 a. m.	99	23.	5:00 p. m.	98.6
17.	4:30 p. m.	98.6	6.	5:00 p. m.	99.4	24.	9:00 a. m.	98.8
18.	10:00 a. m.	98.6	7.	9:00 a. m.	98.6	24.	5:00 p. m.	98.4
18.	5:00 p. m.	99.6	7.	5:00 p. m.	99	25.	9:00 a. m.	98.8
19.	9:00 a. m.	99.4						

The animal showed no symptoms whatever during the entire course of the experiment. During the latter part of the feeding he increased in flesh and his coat became quite glossy. After being kept under observation until March 25, the animal was used for another purpose.

Experimental horse No. 13. This animal was a large, old, sorrel horse, thin and weak, and somewhat lame in hind legs. The animal had been down in the stall two or three times before it was purchased by the laboratory. The feeding of good ensilage to this animal was begun Feb. 3, 1903, and after three days the decomposed ensilage was substituted for the good. This was kept up until February 10, when the animal, being in poor physical condition was given again good ensilage and a small grain feed added. It was kept on ensilage until March 5. During this time it exhibited no symptoms of any sort, but increased in weight. On February 22, the animal's temperature arose and remained up for three days without any assignable cause except indigestion. It was kept under observation until April 16, when it was used for another purpose. The temperature during this period is herewith appended.

During the month and a half of the experiment these two horses were given about one ton of the ensilage, one-half of which was in a decomposed condition.

1903.			1903.			1903.		
Date. Feb.	Hour.	Temp.	Date. Feb.	Hour.	Temp.	Date. March.	Hour.	Temp.
3.	4:00 p. m.	99.8	17.	10:00 a. m.	99.6	1.	9:15 a. m.	99.6
4.	9:00 a. m.	98.2	17.	4:00 p. m.	100.2	1.	5:00 p. m.	100
4.	5:00 p. m.	100.3	18.	10:00 a. m.	98.8	2.	9:30 a. m.	99.4
5.	11:00 a. m.	99.8	18.	5:00 p. m.	100	2.	5:00 p. m.	100.6
5.	5:30 p. m.	100.4	19.	9:00 a. m.	100.2	3.	9:00 a. m.	99.4
6.	9:00 a. m.	100.2	19.	5:00 p. m.	99.8	3.	5:00 p. m.	100.2
6.	5:00 p. m.	100.2	20.	9:00 a. m.	100.6	4.	9:00 a. m.	99.8
7.	11:30 a. m.	99.2	20.	5:00 p. m.	100.4	4.	5:00 p. m.	100.2
7.	5:05 p. m.	100.2	21.	9:00 a. m.	100.4	5.	9:00 a. m.	100
8.	10:20 a. m.	99.4	21.	5:00 p. m.	100.4	5.	5:00 p. m.	100.4
9.	10:30 a. m.	100.4	22.	9:00 a. m.	101	6.	9:00 a. m.	100
9.	4:30 p. m.	99.6	22.	5:00 p. m.	103.2	6.	5:00 p. m.	100
10.	9:00 a. m.	99.4	23.	9:00 a. m.	103	7.	9:00 a. m.	99.8
10.	4:30 p. m.	100	23.	5:00 p. m.	104.6	7.	5:00 p. m.	100
11.	10:30 a. m.	99.8	24.	9:00 a. m.	104	8.	9:00 a. .m	100.2
11.	4:30 p. m.	99.8	24.	5:00 p. m.	104.2	8.	5:00 p. m.	100
12.	10:20 a. m.	100	25.	9:00 a. m.	103.4	9.	9:00 a. m.	99.8
13.	10:30 a. m.	99.4	25.	5:00 p. m.	102.8	9.	5:00 p. m.	100.4
13.	4:45 p. m.	100	26.	9:00 a. m.	100.6	10.	9:00 a. m.	99.4
14.	4:30 p. m.	100.2	26.	5:00 p. m.	101.2	10.	5:00 p. m.	99.8
15.	10:00 a. m.	99.6	27.	9:00 a. m.	100	11.	9:00 a. m.	99.4
16.	10:30 a. m.	99.4	27.	5:00 p. m.	100.8	11.	5:00 p. m.	99.8
16.	4:45 p. m.	99.6	28.	9:15 a. .m	101.2	12.	9:00 a. m.	100
			28.	5:00 p. m.	100.8	12.	5:00 p. .m	99.6

1903.			1903.			1903.		
Date. March,	Hour.	Temp.	Date. March.	Hour,	Temp.	Date. April.	Hour.	Temp.
13.	9:00 a. m.	100.2	24.	9:00 a. m.	100.4	4.	5:00 p. m.	100.4
13.	5:00 p. m.	100.6	24.	5:00 p. m.	100.2	5.	10:00 a. m.	100.2
14.	9:00 a. m.	100.4	25.	9:00 a. m.	100.4	5.	4:30 p. m.	100.2
14.	5:00 p. m.	.....	25.	5:00 p. m.	100.2	6.	10:00 a. m.	100.6
(No. temp.; floor oiled.)			26.	9:00 a. m.	100.2	6.	5:00 p. m.	101
15.	10:00 a. m.	100.2	26.	5:00 p. m.	100.2	7.	9:15 a. m.	100.2
15.	5:00 p. m.	100.4	27.	9:00 a. m.	100.4	7.	5:00 p. m.	100.6
16.	9:00 a. m.	100	27.	5:00 p. .m	100.2	8.	9:00 a. m.	100.4
16.	5:00 p. m.	100.2	28.	9:00 a. m.	100.6	8.	5:00 p. m.	100.4
17.	9:00 a. m.	99.8	28.	5:00 p. m.	101	9.	9:30 a. m.	100.4
17.	5:00 p. m.	99.8	29.	9:30 a. m.	100.6	10.	8:30 a. m.	100.8
18.	9:00 a. .m	100	29.	4:30 p. m.	100.4	10.	5:30 p. m.	100.2
18.	5:00 p. m.	100.4	30.	9:30 a. m.	100.8	11.	8:15 a. m.	100.4
19.	9:00 a. m.	99.8	31.	9:30 a. m.	100.4	11.	5:00 p. m.	100.2
19.	5:00 p. m.	100.6	31.	5:00 p. m.	100	12.	10:00 a. m.	100.8
20.	9:00 a. m.	100.4	April.			12.	4:30 p. m.	100.4
20.	5:00 p. m.	100.4	1.	9:15 a. m.	100.4	13.	5:00 p. m.	100.6
21.	9:00 a. m.	100.2	1.	5:00 p. m.	100.2	14.	8:45 a. m.	100
21.	5:00 p. m.	100	2.	9:15 a. m.	100.2	14.	5:00 p. m.	100 6
22.	9:30 a. m.	99.6	2.	5:00 p. m.	100.2	15.	9:00 a. m.	101
22.	5:00 p. m.	100.6	3.	9.15 a. m.	100	(Down in stall.)		
23.	9:00 a. m.	100	3.	5:00 p. m.	100.4	15.	5:00 p. m.	100.6
23.	5:00 p. m.	100.4	4.	9:30 a. m.	100.6	16.	9:00 a. m.	100.2

Beaver Creek Township, Rock County (*Horses*)—Sunday, Jan. 18, 1903, Dr. Brimhall visited the farm of S. Bros., Beaver Creek Township, Rock County, eight miles west of Luverne, Minn. He found a two-year-old gray roan filly up in slings. This animal, noted as No. 31, in laboratory record, was taken sick January 17, and was unable to get up without help, but after being lifted with the slings was able to stand without much difficulty. When taken out of the slings walked without showing any special weakness. The only way inco-ordination showed was when the animal was turned shortly. It ate with difficulty. Coarse food was partially masticated and allowed to drop from the mouth, but it was able to soften the oats sufficiently to permit of their being swallowed. Drinking was difficult also.

Temperature 101.2°, pulse about 45. By artificial light the pupils were apparently not as sensitive as they should be, but when the horse was led into the sunlight they contracted normally. A large number of *strongulis tetracanthis* were noticed attached to the movement from the bowels.

This horse was found dead in the slings on the morning of Thursday, January 22, the owners not having noticed any change in its condition on the night previous. The head and a portion of the backbone were packed and sent to the laboratory.

The specimens when received in the laboratory were all very solidly frozen. On examination the meninges of both brain and cord appeared to be intensely congested.

Cultures were made from the meninges of brain and cord and from the substance of the brain. After incubation the following bacteria were obtained:

1. *Meninges of brain.* Large spore-bearing bacilli and diplococci (*diplococcus pneumoniæ*).
2. *Brain substance.* Large spore-bearing bacilli and diplococci (*diplococcus pneumoniæ*).
3. *Meninges of cord.* Large spore-bearing bacilli and diplococci (*diplococcus pneumoniæ*).

On Jan. 27, 1903, Dr. Brimhall, accompanied by Dr. Wilson, again visited the farm.

On inquiry it was found that S. Bros. had lost in the latter part of March, 1902, two horses which exhibited symptoms similar to those above described, though they died in less than two days after the onset. The horses which died in March, 1902, had been running in a barnyard with cattle, hogs and other horses. Shortly after the death of the two animals the other horses were removed from the barnyard. All the horses in the spring of 1902 were drinking from a small creek, the water of which was very foul with decaying vegetation. Later in the spring the barnyard was cleaned up, the horses turned into pasture and a new water supply secured from a deep well. No more trouble occurred until December, 1902, when a horse became suddenly sick showing difficulty in swallowing; went down on December 20, and died December 21.

December 31 another animal became sick and died January 3, 1903. January 4, 1903, a blind mare which had been kept in the stable and led to water became sick and died in about thirty-six hours after the onset of symptoms. She was very violent, struggling severely from the first. Jan. 10, 1903, another animal, which had had a subnormal temperature two days before, died. The next horse to become sick was No. 31, seen by Dr. Brimhall. The horses were all being fed on grain, clean hay and straw. There was no ensilage on the place.

January 27, three horses were sick and down with the disease. One seven-year-old gray horse was taken sick January 25, and went down January 26. This is designated No. 32 in these notes. The second, a buckskin colored yearling colt, became sick the morning of January 26, and went down in a few hours after first symptoms

appeared. This one is designated as No. 33 in succeeding notes. The third, No. 34, an iron gray yearling colt, had appeared to have some difficulty in chewing and swallowing in the afternoon of January 26, and was found down on its side but able to rise with assistance in the evening. The following morning, January 27, it was down and unable to rise. The temperature of these horses was taken by Dr. Brimhall:

Horse No. 32, 99.6°.
Horse No. 33, 99.2°.
Horse No. 34, 98°.

These animals were all lying out doors, exposed to the cold wind. No. 34 was shivering at the time.

Autopsy Notes, (*Horse No.* 32).—The animal was killed by bleeding and an autopsy made at once.

Throat and pharynx were found normal. The lungs showed hypostasis in dependent portions. On the upper right lung a large blood stained area was present. On cutting into this the staining was found to be very superficial. The horse had been lying on this, the right side, on the previous day and had been turned over. The staining was probably the remains of hypostasis which had been almost eradicated by the change in position.

The epicardial surface of the heart showed considerable roughening or pitting. There was no change of color about these roughened areas and no deposits of fibrin. The heart in its pericardium had been exposed for some time to a cold wind before the pericardium was opened. This apparent roughening may have been caused by chilling of the tissue before it was completely dead. Several small hæmorrhagic areas were found in the endocardium. The spleen was small, tough and dry; normal in color. The liver was yellowish and fatty in appearance. It also showed small petechial hæmorrhages scattered over the surface. The alimentary canal and mesentery were apparently normal except for the presence of aneurisms containing *strongylus armatus* within the mesenteric arteries. The stomach contained large numbers of bots. Kidneys were apparently normal except for a small collection of serum extracapsular about the right one. The frontal sinuses were opened and the lining found to be apparently normal. On opening the spinal canal in the cervical region a large quantity of yellowish serum flowed out. The meninges of both brain and cord were markedly congested. No pus was present. Considerable fibrin was adherent to the occiput about the foramen magnum extra-durally.

The base of the cerebellum and region of the pons showed the greatest congestion. The auditory nerves were apparently fatty in almost all their bundles.

Direct coverslip preparations, cultures and tissues for histological examination were collected from lung, heart, spleen, liver, kidney, frontal sinuses, brain, cervical and lumbar spinal cord.

Direct coverslip preparations stained with eosin and methylene blue showed bacteria as follows:

Lung. No bacteria.

Heart. No bacteria.

Spleen. No bacteria.

Liver. No bacteria.

Kidney. No bacteria.

Frontal sinus. No bacteria.

Meninges of brain. Lanceolate, encapsulated, Gram-staining diplococci, some intra- and some extra-cellular.

Meninges of cervical cord. Lanceolate, encapsulated, Gram-staining diplococci, some intra- and some extra-cellular.

Meninges of lumbar cord. Lanceolate, encapsulated, Gram-staining diplococci, some intra- and some extra-cellular.

Cultures in broth and on serum after incubation showed bacteria as follows:

Lung. No bacteria.

Heart. No bacteria except one broth culture in which a large spore-bearing bacillus was found (probably a contamination).

Spleen. No bacteria.

Liver. No bacteria.

Kidney. No bacteria.

Frontal sinus. No bacteria.

Brain. Diplococci indistinguishable from those described under case No. 29. See page 155 (*Diplococcus pneumoniæ.*)

Cervical cord. Diplococci indistinguishable from those described under case No. 29. See page 155. (*Diplococcus pneumoniæ.*)

Lumbar cord. Diplococci indistinguishable from those described under case No. 29. See page 155. (*Diplococcus pneumoniæ.*)

Autopsy Notes (*Horse No.* 33).—The colt was killed by bleeding and an autopsy made at once.

The throat, pharynx and trachea were apparently normal. Lung was normal. Heart showed small hæmorrhages in endocardium. Spleen small in size, normal in color, tough and fibrous. Liver was fatty. Stomach contained bots. The remainder of the alimentary canal was normal. The mesenteric arteries contained several areas in which the walls were roughened and thickened due to the presence of *strongylus armatus.* The kidneys were normal. On opening the spinal canal in the cervical region a large amount of yellowish serum escaped. The meninges of the brain and spinal cord were markedly congested, especially about the cerebellum and pons. The frontal sinuses were examined and found to be apparently normal.

Direct coverslip preparations, cultures and tissues for histological examination were collected from the lung, heart, spleen, liver, kidney, frontal sinuses, brain and cervical and lumbar cord.

Direct coverslip preparations stained with eosin and methylene blue showed bacteria as follows:

Lung. No bacteria.

Heart. No bacteria.

Spleen. No bacteria.

Liver. No bacteria.

Kidney. No bacteria.

Frontal sinus. Small, slender bacilli.

Meninges of brain. Diplococci indistinguishable from those described under case No. 29. See page 155. *(Diplococcus pneumoniæ)*.

Cervical and lumbar cords. Diplococci indistinguishable from those described under case No. 29. See page 155. (*Diplococcus pneumoniæ*).

Cultures in broth and on serum on examination showed bacteria as follows:

Lung. No bacteria.

Heart. No bacteria.

Spleen. Small streptococci.

Liver. No bacteria.

Kidney. No bacteria.

Frontal sinus. Small, slender motile bacilli.

Meninges of brain. Diplococci indistinguishable from those described under case No. 29. See page 155. *(Diplococcus pneumoniæ*) and a few colonies of streptococci.

Cervical spinal cord. Diplococci indistinguishable from those described under case No. 29. See page 155. *(Diplococcus pneumoniæ*) and a few colonies of streptococci.

Lumbar spinal cord. Diplococci indistinguishable from those described under case No. 29. See page 155. (*Diplococcus pneumoniæ*) and a few colonies of streptococci.

February 28, rabbit No. 689 was inoculated in left subdural space with 0.2 c.c. of an emulsion of water of condensation of the serum culture, second from horse No. 33. The animal was exhibiting marked symptoms of meningitis on the morning after inoculation and was dead by evening of the same day, March 1.

March 3, 1903, a pig (No. 1), weight about 50 pounds, was inoculated subdurally over the lumbar cord with about 7 c.c. of the emulsion of a 24-hour broth and a 24-hour serum culture, originally from rabbit No. 689. Four hours after the inoculation the pig began to be excited; ran about the stall for some time, then became partially paralyzed in the posterior extremities and though still excited was unable to drag itself about the stall. It was found dead on the morning of the day following the inoculation. On laying bare the spinal cord and brain, the spinal canal was found to contain a large excess of fluid. The pia of both cord and brain was intensely congested. Direct coverslip preparations and cultures from the meninges of cord and brain showed *diplococcus pneumoniæ* in abundance unmixed with other organisms.

March 6, 1903, at 10:20 a. m., experimental horse No. 15 was inoculated by lumbar puncture through the dura of the spinal cord with 7 c.c. of a broth culture second from experimental pig No. 1 and (horse) meningitis case No. 33.

This animal had been under observation in the laboratory for 14 days, during which time his temperature had been taken twice daily and had varied from 98.8° to 100°. The animal was in perfect health at the time of the inoculation. The following notes of his symptoms are herewith given.

Inoculated 10:20 a. m., 10 c.c. emulsion.

1903. Date. March.	Hour.	Temp.	
6.	12:00 m.	100	Fed. Did not eat.
6.	1:00 p. m.	100.2	Trembling.
6.	1:20 p. m.	.....	Trembling. Respiration 24, in co-ordination.
6.	2:30 p. m.	.....	Water coming from nose in drops.
6.	3:30 p. m.	103	Unable to stand still. Respiration 56.
6.	4:20 p. m.	.....	Wet with perspiration. Respiration 48.
6.	5:00 p. m.	103	Repiration 48. Very restless on forefeet. Sensitive to touch. No urine or fæces voided since inoculation.

Date. March.	Hour.	Temp.	
7.	7:30 a. .m	102.2	Not so restless. Stronger on his legs.
7.	9:00 a. m.	102.4	Unable to put down his head to drink.
7.	1:00 p. m.	102.6	Eats grain and hay.
7.	5:00 p. m.	102.6	Milky substance running from nostrils.
8.	9:00 a. m.	102.6	Still nervous. Eating well.
8.	5:00 p. m.	102.2	Nervous. Eats oats and a little hay.
9.	9:00 a. m.	101.6	Heavy perspiration on sides and flanks, spasmodic jerking of flanks.
9.	5.00 p. m.	102.4	Still nervous. Eats hay. No oats.
9.	7:50 p. m.	.....	Down on right side, kicking vigorously, apparently in pain.
10.	8:00 a. m.	.....	Found dead.

Autopsy made at 9 a. m., body still warm.

On removing the skin, several small hæmorrhages were found in the subcutaneous connective tissue. The lungs showed some congestion, probably hypostatic.

The heart showed small hæmorrhages in the anterior auriculo-ventricular groove.

Spleen was normal in consistency and size. Weight, three pounds.

Liver normal in appearance. Weight, 15 pounds.

Intestines apparently normal. Large aneurism filled with strongyli in the middle mesenteric artery.

Kidneys apparently normal. Weight of left kidney, one and three-quarters pounds.

On opening the spinal canal and the dura, the subdural space was found filled with a hæmorrhagic exudate. This was most marked in the lumbar region several inches above and below the point of injection, but extended in a lesser degree to the cervical region. The meninges of the brain especially at the base were also markedly inflamed.

Direct coverslip preparations, cultures and tissues for histological examination were collected from lung, heart, spleen, liver, kidney and sacral, lumbar, and cervical spinal cord and meninges of brain.

Direct coverslip preparations from meninges of the spinal cord stained with eosin and methylene blue showed large diplococci, indistinguishable from those inoculated. After 48 hours in the incubator cultures gave results as follows:

From the lung, heart, spleen, liver and kidney, no growth.

From the meninges of the spinal cord at the site of inoculation, four inches back of the site of inoculation, 10 inches in front of the

site of inoculation, cervical region and the meninges of the brain, all gave apparently pure cultures of a large Gram-staining diplococcus indistinguishable from that inoculated—(*diplococcus pneumoniæ.*)

Autopsy Notes (*Horse No.* 34).—Animal was killed by bleeding and an autopsy made at once.

Throat, pharynx and trachea normal Lungs normal. Endocardium showed small hæmorrhages. The spleen was small and tough; normal in color. Liver fatty. Stomach contained bots. The remainder of the alimentary canal showed no lesions. The greater mesentery showed an enlargment about four inches in length containing dark colored fluid and a number of immature worms (*strongylus armatus*). Kidneys were normal. Frontal sinuses were normal. Upon opening the dura in the cervical region of the spinal cord a large amount of bloody serum flowed out. The meninges of the brain and spinal cord were congested, markedly so about the base of the cerebellum and pons. Direct coverslip preparations, cultures and tissues for histological examination were collected from the lungs, heart, spleen, liver, kidneys, frontal sinus and brain and cervical and lumbar regions of the spinal cord.

Direct coverslip preparations stained with eosin and methylene blue on examination showed bacteria as follows:

Lungs. No bacteria.

Heart's blood. No bacteria.

Spleen. No bacteria.

Liver. No bacteria.

Kidney. No bacteria.

Frontal sinus. Staphylococci.

Meninges of brain. Diplococci indistinguishable from those described under case No. 29. See page 155. (*Diplococcus pneumoniæ*).

Cervical spinal cord. Diplococci indistinguishable from those described under case No. 29. See page 155. (*Diplococcus pneumoniæ*).

Lumbar spinal cord. Diplococci indistinguishable from those described under case No. 29. See page 155. (*Diplococcus pneumoniæ*).

Cultures in broth and on serum on examination showed bacteria as follows:

Lungs. No bacteria.

Heart. No bacteria.

Spleen. No bacteria.

Liver. No bacteria.

Kidneys. No bacteria.

Frontal sinus. Staphylococcus pyogenes albus.

Meninges of brain. Diplococci indistinguishable from those described under case No. 29. See page 155. *(Diplococcus pneumoniæ)*.

Cervical spinal cord. Diplococci indistinguishable from those described under case No. 29. See page 155. *(Diplococcus pneumoniæ)*.

Lumbar spinal cord. Diplococci indistinguishable from those described under case No. 29. See page 155. *(Diplococcus pneumoniæ)*.

Feb. 9, 1903, rabbit No. 672 was inoculated in left ear vein with 0. 3 c. c. with broth culture of *diplococcus pneumoniæ* from this case. The animal exhibited no symptoms during the ensuing two months, when it was used for another purpose.

Later S. Brothers reported the death of two more horses during the month of February from the same disease.

It will be seen from the above notes that *diplococcus pneumoniæ* was recovered unmixed with other organisms from the central nervous system of all of the horses examined in this outbreak; that it was inoculated in pure culture into rabbits, one pig and one horse; that in each of these animals symptoms and lesions of meningitis with death were produced; that the organism was recovered unmixed with other bacteria at autopsy of each of the animals. The demonstration of the etiological significance of the diplococcus pneumoniæ in these cases would therefore seem to be complete. It may be noted that none of the horses in this last described outbreak had ever been fed on ensilage, but had been on good hay and grain, and well cared for.

Lebanon Township, Dakota County, (Sheep)—March 18, 1903, Dr. Annand visited the farm of Mr. D. D., in Lebanon Township, Dakota County, near Rosemount, and investigated an outbreak of a disease among sheep. The first symptoms the sheep showed were a drooping of the head and listlessness. "Later they would elevate the head quite suddenly and hold it in the air for a while. In a couple of days they would go down and be unable to rise. While

down they would keep the head extended as far back as possible. They had lived from three days to two weeks after getting sick. There was only one that had made what seemed to be a partial recovery. This was able to rise and move about, but had taken a relapse." Eight out of a herd of 60 had been lost. Dr. Annand made autopsies on two of the animals and brought material to the laboratory for examination. There was inflammation of the meninges and the gray matter of the spinal cord. At the base of the brain there was considerable inflammation. Externally the surface of the brain was very highly congested. On cutting into the cord some fluid was discharged.

Sheep 1.—Smears from the meninges stained by eosin and methylene blue showed what appeared to be large and small bacilli, possibly diplococci.

Cultures from the liver gave a diplococcus in pure culture (*diplococcus pneumoniæ*). Cultures from the heart and meninges gave colon bacilli. No growth from any of the other cultures.

Sheep 2.—Cultures from meninges gave *diplococcus pneumoniæ* in pure culture. Cultures from the spleen gave *diplococcus pneumoniæ* and a white staphylococcus. No growth from any of the other cultures.

TABLE SHOWING ANIMALS DEAD OF CEREBRO-SPINAL MENINGITIS FROM 1898 TO APRIL, 1903.

HORSES.

No. of Outbreak.	Date.	County.	Animals Sick.	Animals Dead.
*1.	June, 1899	Grant	6	6
*2.	June, 1900	Ramsey	1	1
*3.	Nov., 1900	Douglas	5	4
4.	Jan., 1903	Freeborn	5	5
5.	Jan., 1903	Rock	12	12
			29	28

CATTLE.

No. of Outbreak.	Date.	County.	Animals Sick.	Animals Dead.
*1.	Sept., 1898	Dakota	5	5
*2.	June, 1900	Ramsey	1	1
*3.	Sept., 1900	Hennepin	3	3
4.	Jan., 1901	Stearns	5	5
5.	Jan., 1901	Carver	6	5
6.	June, 1901	Rice	9	9
7.	Sept., 1901	Lyon	7	5
8.	Feb., 1902	Stearns	..	..
			36	33

*These cases have been reported in the Biennial Reports of this Board for the years indicated by their dates.

SHEEP.

No. of Outbreak.	Date.	County.	Animals Sick.	Animals Dead.
1.	Mar., 1903......	Dakota	8	8

SWINE.

No. of Outbreak.	Date.	County.	Animals Sick.	Animals Dead.
1.	Jan., 1903......	Carver	9	9
15.			82	78

Summary.—1. The preceding detailed statement and table show that from September, 1898, to April, 1903, this board has investigated five outbreaks of cerebro-spinal meningitis in horses, eight in cattle, one in sheep and one in swine, making 15 outbreaks in all. These have been distributed in 11 counties. Of the 29 horses sick of the disease, 28 have died. Of the 36 sick cattle, 33 have died. All of the eight sheep and nine swine sick of the disease died, making a total of 82 sick animals with 78 deaths, or a mortality of about 95 per cent.

2. The symptoms may be summarized as follows:

Horses.—There was usually "slobbering" at the mouth, uneasiness, loss of power of deglutition, posterior inco-ordination, gradual posterior paralysis, rapidly ascending, and rapid loss of sensation over posterior extremities. In some instances evidence of involvement of the meninges of the brain was shown by frenzy and failure of pupils of eyes to react to light. Temperatures ran as high as 105° F., but dropped to normal or sub-normal as paralysis ascended.

Cattle.—In most of the cattle examined the symptoms indicated early brain involvement. The animals, at first somewhat stupid, but with a wild staring look in the eyes, shortly became frenzied and rushed about the enclosure attacking other animals. The pupils failed to react to light and some of the animals became, apparently, completely blind. After a short time, the posterior extremities showed inco-ordination, which was followed by both motor and sensory paralysis, which progressed to the death of the animal.

Sheep.—In the only outbreak observed among sheep, the symptoms began with listlessness and drooping and shaking of the head. After a little while the animals became unable to stand. When lying down the head was retracted as far as possible. Animals died after an illness lasting from two to 14 days.

Swine.—In the only outbreak observed in swine, the disease took a sub-acute course. The animals had recurrent "fits," during which time they had short gasping respiration and paralysis of the posterior extremities. The attacks became more frequent and longer in duration after a few days until the animals were continually paralyzed. The paralysis slowly increased and the animals died after about two weeks' illness.

3. No significant lesions were found at autopsy in any of the animals except in the central nervous system. In horses, on opening the spinal canal, a large amount of yellowish or red colored serum escaped. In several cases a quantity of yellowish coagulated serum (fibrin) was attached to the pia of the cord and base of the brain. The meninges of both the cord and brain were uniformly congested, especially in the cervical region of the cord and about the base of the cerebrum.

In cattle, while there was some increase in the amount of cerebro-spinal fluid, it was not so markedly increased as in the horses. The meningeal inflammation was clearly observable. This was especially true of the base of the brain and upper spinal cord.

The same was true of the sheep and swine examined.

4. Of the nine horses on which laboratory examinations have been made, all have shown histological lesions of meningitis with the presence of diplococcus pneumoniæ in direct coverslip preparations, tissues and cultures from the central nervous system.

During the time that the examinations were being made on the above mentioned cases of meningitis in horses, cattle, sheep and swine, similar examinations were made on 16 cases of suspected meningitis in man. The strains of diplococci isolated from the human cases were carefully compared with those isolated from animals. It has been impossible to differentiate the organisms from diplococcus pneumoniæ obtained from human sources by cultural methods.* The variation in acid production and milk coagulation is not greater than between different strains isolated from human sources. When inoculated into rabbits, the organisms appear to have a uniformly less degree of virulence for these animals than do freshly isolated strains of diplococcus pneumoniæ from human sources. This variation, however, is not greater than the variation between different strains of diplococcus pneumoniæ from meningitis and pneumonia in man. Besides a number of rabbit inoculations,

*For cultural characteristics see page 461 Biennial Report this Board for 1899-1900, and p 155 of this report.

the ætiological relationship of diplococcus pneumoniæ to meningitis in horses has been further shown by its inoculation into three horses, one subcutaneously, and into the carotid artery, another lnder the dura of the brain and the third under the dura of the lumbar cord. All of these animals died after exhibiting symptoms of meningitis. At autopsy, the inoculated organism was recovered from the central nervous system unmixed with other bacteria.

It is worthy of note that one strain of diplococcus pneumoniæ originally from a *horse,* after a single passage through a rabbit, was inoculated into the dura of the lumbar cord of a *pig.* The pig died after exhibiting symptoms of meningitis and diplococcus pneumoniæ was obtained in direct coverslip preparations and cultures from the meninges of both cord and brain unmixed with other organisms.

It should be noted that of the five outbreaks of meningitis in horses, only one gave a history of ensilage feeding. It so happened that all the other animals were good horses and were being well cared for and fed on good sound grain or hay. About one ton of ensilage from the silo concerned in the one outbreak noted above, was fed to two horses in the Research Laboratory without the production of any symptoms of meningitis. In the same outbreak *diplococcus pneumoniæ* was isolated from both of the two horses examined.

Of the five cows on which laboratory examinations were made, histological lesions of meningitis were present in all. From one an organism closely resembling, if not identical with, diplococcus intracellularis in man, was isolated. From three of the others, diplococci indistinguishable from diplococcus pneumoniæ were found in the meninges of the brain and cord.

From the meninges of the two sheep examined, diplococcus pneumoniæ was isolated.

Cultures from the meninges of the two pigs examined showed diplococcus pneumoniæ.

5. The clinical diagnosis of meningitis due to diplococcus pneumoniæ in horses, cattle, sheep and swine would seem to be exceedingly difficult to make. The disease described by Pearson* as forage poisoning in horses apparently so closely resembles meningitis due to diplococcus pneumoniæ that it would seem that only a careful bacteriological examination would serve to differentiate the two. The differentation of the disease from rabies in cattle is practically

*Journal of Comparative Medicine and Veterinary Archives, 1900, Vol.. XXI, P. 654.

impossible without a laboratory examination. The meningeal form of hæmorrhagic septicæmia in cattle (see page 113 of this report) does not ordinarily produce so much excitement as does meningitis in cattle due to diplococcus pneumoniæ, but where the meninges of the brain are early affected by *B. bovisepticus* (see *hæmorrhagic septicæmia* outbreak No. 75) the symptoms so closely resemble the symptoms caused by diplococcus pneumoniæ that a careful laboratory examination is necessary in order to differentiate the two.

In making post-mortem examinations of animals it must be borne in mind that the gross lesions of meningitis sometimes appear to be insufficient to account for the severity of the symptoms. The presence or absence of inflammatory changes or bacteria can frequently be determined only by histological and cultural examinations. If these are not carefully made, the meningeal character of a disease with suggestive symptoms cannot properly be excluded.

6. The treatment of meningitis as it has come under the observation of this board would seem to be of little avail.

7. The separation of the sick from the well animals and the careful disinfection with chemicals and by fire appear to be the most effective means of checking the progress of the disease in a herd.

8. In connection with meningitis in various animals, there had been planned in the laboratory a series of experiments consisting of cross inoculations and cross immunizations of various animals with cultures of diplococcus pneumoniæ from various sources, to determine the variation or identity of the infecting bacteria. In connection with this it was hoped that it might be possible to produce an immunizing serum by means of some of the strains virulent to larger animals.

CORN STOCK DISEASE IN CATTLE.

In past years the term *corn stock disease* has been applied in certain cases where one or several animals have been afflicted with a set of symptoms not well defined. The only basis for such a diagnosis has been that the animals, at the time of the outbreak, were running in standing corn stalks.

In Minnesota since the careful study of *hemorrhagic septicœmia* and of *meningitis in cattle* was taken up by this Board in 1901, cases have been found which were thought by the farmers to be corn stock disease, but which in every instance after a careful investigation has proven to be either *hemorrhagic septicœmia* or *meningitis*.

Although a close watch was kept by the veterinarians under this board during the period already referred to for this so-called corn stock disease, not a single case has been found. It would seem that if there is such a disease some cases should have occurred, for previous to 1901 the term was in constant use, as applicable to certain outbreaks of disease among cattle in Minnesota.

The natural conclusion must be that if there is such a disease among cattle, it does not exist in Minnesota at the present time. The inference may go even farther:—that there has been no such disease in the past, and that the name was an unscientific term used to cover a group of diseases that had not received proper investigation in Minnesota prior to 1901. (See pages 114-115 of this report.)

SHEEP SCAB.

This disease needs watching, lest it become more general throughout the state. The sheep industry is of great importance in Minnesota. The feeding of sheep for market is carried on to quite an extent at many shipping points.

The Bureau of Animal Industry has been of great assistance in tracing out this disease, for in the event of scabby sheep being sent to the great packing houses for slaughter the disease was at once recognized and the fact reported to this Board by the federal authorities. The federal report gave the name of the shipper, the point from which and to which the shipment was made, the numbers and owner of the cars in which the shipment was made, etc. With such reports from the federal authorities it has been an easy matter to trace the sheep to the owners or shippers.

The railroad officials appreciate their responsibility in handling these diseased sheep and have been ready and willing to assist in preventing their shipment. During the past two years the railroad agents have been furnished by the State Board of Health with affidavits to be filled out and signed at the time of shipment by the owner or shipper to the effect that the sheep were free from scab at the time of shipment and that they had not been in contact with other sheep affected with the disease.

The State Board of Health issued a circular on sheep scab which reads as follows:

Nature of the Disease.—The disease commonly known as sheep-scab is a contagious parasitic skin disease. The parasites or mites which cause this disease are so small that they are seen with difficulty by the unaided eye. These little parasites multiply with amazing rapidity. Their eggs hatch in from four to seven days and the young mites mature in about fourteen days. The irritation of the skin by these mites causes the formation of crusts or scabs and shedding of the wool.

Symptoms.—Sheep affected with sheep-scab (scabies) are uneasy, often biting their sides, pulling out tufts of wool and scratching themselves against fences or other objects. The loosened tufts of wool give the fleece a ragged appearance. As the disease advances, thick crusts or scabs form and the wool is removed over large areas, leaving the skin quite bare for a time. When the animals have been heated by exercise the itching sensation is increased.

How the Disease Spreads.—Healthy sheep will contract the disease by coming in contact with diseased ones or by being placed in yards or cars previ-

ously occupied by diseased sheep, unless the pens, yards or cars have been recently disinfected. Sheep should never be shipped in stock cars which have not been thoroughly cleaned. It is a good rule to always dip new sheep before putting them in pens with others.

Treatment.—The two dips approved by the Federal authorities (see regulations) are: (1) the tobacco and sulphur, or (2) the lime and sulphur dips. The tobacco and sulphur dip is probably best for general use by farmers. The dip should be made with a reliable extract of tobacco, which will make, when used according to directions, a solution containing not less than five one-hundredths of one per cent of nicotine. To the tobacco mixture always add two per cent flowers of sulphur.

Formula:	Extract of tobacco (of the required strength)...	2 lbs.
	Flowers of sulphur............................	16 lbs.
	Water	100 gal.

When being used the dip should be kept at a temperature as near 110° F. as is possible, and should be frequently stirred. When the weather will permit, the sheep should be shorn before treatment is begun. Keep each animal in the dip two minutes and be sure that its head is thoroughly wet.

Always dip the entire flock.

After dipping, place the sheep in non-infected pens and repeat the dipping in from eight to ten days. The old infected pens should be thoroughly disinfected by first removing and burning all litter, then cover all interior surfaces, to at least five feet from the ground, with a coat of fresh whitewash.

A convenient and durable dipping vat for a small flock can be made of galvanized iron. One end of the vat should be made sloping, and it should be seven feet long at the top, five feet at the bottom, two feet wide and five feet deep. A dripping rack should be built the proper height, with floor arranged with cleats which will give the sheep a foothold, and side pieces which will conduct the dip which drips from the sheep, into the vat. In order to assist the sheep in getting into the rack, cleats should be nailed to boards, which can be placed in the sloping end of the vat and fastened to the rack. Until the sheep have become sufficiently dry, so that there is no dripping from the wool, they should be kept in a pen that is free from grass, hay or food of any kind.

There are two tobacco extracts on the market which have proved reliable: Skabcura and Black Leaf dip. They can be purchased from Noyes Bros. & Cutler, wholesale druggists, St. Paul, or from any reliable drug company. Always be sure to add two per cent flowers of sulphur to a dip made with any preparation of tobacco.

S. D. BRIMHALL, V. M. D.,
Director Veterinary Department.

March 3, 1902.

The rules relating to quarantine and its violation were also formulated and published. They read as follows:

1. Animals affected with sheep scab are hereby held to be affected with a contagious or infectious disease as designated by the law of this State

and the rules of the State Board of Health. All persons and corporations are hereby forbidden to transport such diseased sheep from any point outside the state to any point with the state, or from place to place within the state, except upon permission in writing from the State Board of Health.

2. Animals that may be reasonably supposed to be affected with sheep scab shall not be allowed to enter any stock yard or other public place where they may come in contact with healthy sheep or where healthy sheep are liable to be placed.

3. All outbreaks of suspicious skin disease among sheep must be quarantined and at once reported to the State Board of Health.

4. All sheep affected with scab or which show any inflamed condition of the skin, and all sheep that have associated in the same flock with such sheep, must be included in the preliminary quarantine.

5. Quarantine must be continued until satisfactory evidence is presented to the State Board of Health that the quarantined animals are not affected with sheep scab; or until the entire flock has been dipped two or more times with intervals of eight days, using a recognized dip according to instructions. (See "Circular of Information Concerning Sheep Scab.")

6. Enclosures wherein sheep affected with scab have been confined must be continued in quarantine for a period of at least eight weeks after such diseased sheep have been removed.

Violation of Quarantine Defined.—It shall be deemed a violation of quarantine for any person to knowingly remove, authorize or cause to be removed any sheep that have been quarantined on account of any contagious or infectious disease, from any farm or enclosure where they have been quarantined, except as provided in rule five (5).

It shall be deemed a violation of quarantine for any person to knowingly cause, authorize, or permit to be placed any sheep, except those already quarantined, in any stable or enclosure that is under quarantine on account of any contagious or infectious disease of sheep.

Many of the large sheep feeders maintain a dipping vat. This is true of the St. Paul Union Stock Yards at South St. Paul.

Sheep scab was reported as follows:

County.	1901. Locality.	1902. Locality.
Blue Earth	Vernon Centre.	Lake Crystal.
Chippewa	Montevideo.	....
Cottonwood	Mountain Lake.	Windom.
Dakota	South St. Paul.	South St. Paul.
Fillmore	Spring Valley.	Harmony.
Freeborn	Albert Lea.	....
Grant		Wendell.
Jackson		Heron Lake.
Lac qui Parle		Lake Side.
McLeod		Hutchinson.
Martin	Conger.	....

County.	1901. Locality.	1902. Locality.
Mower		Austin.
"		Le Roy.
"		Iona Lake.
Murray		Fulda.
"		Chandler.
"		Avoca.
"		
Nobles	Adrian.	
"	Dundee.	
Olmsted	Eyota.	Horton.
"		Horton.
Pipestone		Jasper.
Redwood	Redwood Falls.	
Renville		Buffalo Lake.
Rock	Hills.	Ash Creek.
Steele	Blooming Prairie.	
Traverse	Brown's Valley.	
Wabasha	Plainview.	
Waseca		New Richland.
"		New Richland.
Washington	Newport.	
Watonwan		St. James.
"		Madelia.
Winona	Winona.	Winona.
Wright		Montrose.
Yellow Medicine	Canby.	

The disease was investigated upon complaint or request as follows:

Date.	Inspector.	County.	Locality.
1901.			
Feb. 14.	Dr. Brimhall	Olmsted	Dover Twp.
Feb. 15.	Dr. Brimhall	Wabasha	Oakwood Twp.
May 17.	Dr. Brimhall	Nobles	Near Worthington.
Nov. 6.	Dr. Annand	Fillmore	Bloomfield Twp.
Nov. 8.	Dr. Annand	Olmsted	Eyota Twp.
1902.			
Jan. 29.	Dr. Brimhall	Lac qui Parle	Lakeside Twp.
Jan. 30.	Dr. Brimhall	Lac qui Parle	Lakeside Twp.
Jan. 31.	Dr. Brimhall	Lac qui Parle	Lakeside Twp.
Feb. 21.	Dr. Brimhall	Wright	Fridley Twp.
Sept. 24.	Dr. Annand	Fillmore	Harmony.
Sept. 26.	Dr. Annand	Grant	Wendell.
Nov. 13.	Dr. Annand	Murray	Fenton Twp.
Nov. 14.	Dr. Annand	Cottonwood	Windom.
Dec. 10.	Dr. Annand	Marshall	Near Warren.

Date. 1901.	Inspector.	County.	Locality.
Jan. 21.	Dr. Annand	Watonwan	Madelia.
Jan. 22.	Dr. Annand	Watonwan	Madelia Twp.
Jan. 22.	Dr. Annand	Watonwan	St. James.
Jan. 22.	Dr. Annand	Watonwan	St. James Twp.
Jan. 23.	Dr. Annand	Murray	Avoca.
Jan. 23.	Dr. Annand	Murray	Chandler.
Jan. 23.	Dr. Annand	Renville	Morton.
Jan. 29.	Dr. Annand	Murray	Slayton.
Jan. 29.	Dr. Annand	Murray	Slayton.
Jan. 29.	Dr. Annand	Murray	Lime Creek.
Jan. 29.	Dr. Annand	Murray	Lime Creek.
Jan. 29.	Dr. Annand	Murray	Lime Creek.
Feb. 18.	Dr. Annand	Blue Earth	Lake Crystal.
Feb. 19.	Dr. Annand	Watonwan	Riverdale Twp.
Feb. 20.	Dr. Annand	Murray	Iona Twp.
Feb. 21.	Dr. Annand	Watonwan	St. James Twp.

SUNDRY DISEASES OF SHEEP.

Obscure diseases—*Bird Island, Renville Co.*—March 23, 1901, Dr. Brimhall visited the farm of Mr. E. I. W., near Bird Island, Renville Co., Minn., to investigate an outbreak of disease among Mr. W.'s sheep. There were 306 sheep on the place the first part of January 1901. Of these 73 had died up to the time of Dr. Brimhall's visit. Autopsies were made on five and tissues from three of the fresh cases taken to the laboratory. At autopsy there were found no inflammatory lesions, but some very slight hæmorrhagic lesions in all of the sheep examined. These in connection with the symptoms described were sufficient to warrant the suspicion of *hæmorrhagic septicæmia.*

The specimens were received in the laboratory March 24. Direct coverslip preparations, plain broth and serum cultures were made from sheep No. 1. Direct coverslip preparations stained with eosin and methylene blue, from sheep No. 1, showed various large and small bacilli. In the specimens from sheep Nos. 1 and 2, stained with eosin and methylene blue, no bacteria were found.

Cultures.—Cultures from all the organs of sheep No. 1 developed *B. coli communis* and in addition, those from the lung, staphylocccci. Cultures from sheep No. 2 and No. 3 all remained sterile after 72 hours in the incubator, excepting as follows: From the lung of sheep No. 2 were obtained large staphylococci; from the contents of the peritoneal cyst of sheep No. 3 were obtained staphylococci.

Summary.—The bacteriological examination reveals nothing as to the cause of the disease.

Lymphadenitis—*South St. Paul Stock Yards.*—April 1, 1902, Drs. Brimhall, Beckman and Wilson visited the South St. Paul Stock Yards and made examinations of a number of sheep which were affected with a peculiar ulcerative condition of the corners of the mouth and tongue. Two of the sheep were killed and autopsies made. Abscesses were found in the lymphatic glands in the cervical region, in the mediastinum and in the retro-peritoneal region. Aside from these and the ulcers about the mouth there were no gross lesions. Cultures were taken from the various abscesses of glands and from the ulcers about the mouth and from the heart's blood of both animals.

From the ulcers, staphylococci, diplococci and small, colon-like bacilli were obtained.

A very minute, non-motile bacillus, resembling in some respects, members of the *hemorrhagic septicæmia* group, was obtained from abscesses on the lip and in the lung and from the heart's blood of one sheep. This organism was inoculated into rabbits with negative results.

The observations were too few and not of sufficiently positive character to permit the drawing of any conclusions therefrom.

Rabbits Nos. 448-49 were inoculated from the gray rabbit noted above. These died after eight and 21 days respectively, having shown symptoms of rabies, thus confirming Dr. Price's diagnosis.

Obscure diseases—*Long Lake, Hennepin Co.*—April 7, 1903, Mr. D. of Minneapolis, telephoned to the laboratory relative to the occurrence of the above disease among newly born lambs on his farm at Long Lake, Minn. Out of 17 lambs from 10 ewes only five survived. The lambs were either born dead or expired immediately after birth. Dr. Brimhall was notified and requested Mr. D. to send specimens to the laboratory.

April 8, two lambs were received at the laboratory by messenger. One of these had been born at noon of April 6th and the other on the morning of April 8th. They had both died shortly after birth. Post-mortem examination was made by Drs. Brimhall and Wilson in the laboratory. No gross lesions were found in either of the animals except very much enlarged thyroid glands.

Direct coverslip preparations from the thyroid glands of each sheep stained with eosin and methylene blue showed a few nucleated red blood cells and many large hyaline cells (*leucocytes*), but no bacteria.

Cultures on serum and in broth gave no growth after 24 hours in the incubator. Pieces of tissue were preserved in 96 per cent alcohol and in 10 per cent formalin for future histological study.

MEAT, MILK AND CHEESE EXAMINATIONS.

Pork—*New Ulm.*—March 18, 1901, there were received in the laboratory, four samples of pork, accompanied by the following letter:

New Ulm, Minn., March 18, 1901.

Minnesota State Board of Health, Minneapolis, Minn.

Gentlemen: Send you by to-day's express four samples of pork, which I would kindly ask you to inspect and report at your earliest convenience, whether the hog of which this pork is, was diseased, if so, whether it was hog cholera.

The hog in question, I sold alive to a party, and after killing it he refused to pay for it, saying it was affected with hog cholera, and I made the agreement that if this were the case, he should not pay for it.

Have numbered the pieces so you may know from which part of the hog they are.

No. 1, is a piece of fat from over the shoulder. As you will notice there is a cavity about in the middle of the fat which, however, might have been nothing but an ulcer.

No. 2 is a piece of ham meat from the shoulder.

No. 3 is a piece of the tenderloin, with a little piece of the kidney in it, and

No. 4 is a piece of tissue which is grown to the ribs near the lungs. Hoping that this explanation will be satisfactory, and awaiting an early reply, I am,

Yours respectfully,

C. S.

To this the following reply was made:

March 18, 1901.

C. S., New Ulm, Minn.

Dear Sir: Your letter dated the 18th of March, was received this morning. The specimens of a slaughtered hog which you mentioned therein, have just been received this afternoon. The question raised by you and which you ask us to settle is a purely medico-legal one and quite outside the scope of the State Board of Health laboratory. There is no state meat inspection.

As I understand the case, it is purely a business question, as to whether remuneration shall be made for one hog, and there is no question of the existence of an epidemic, or a number of cases of infectious or contagious diseases among animals, at issue. If I am misinformed in this matter and there is existing amongst yours, or other animals in that neighborhood, a contagious or infectious disease, I would suggest that you write to Dr. Bracken, Secretary of the State Board of Health, at St. Paul, Minn. Should the circumstances seem to warrant it, I am sure the veterinary department of the board would take up the question of investigating the disease amongst the hogs. Pending instructions from you as to the disposal of the material, we shall keep it for the next two or three days, in our cooler.

I might add that the likelihood of demonstrating the presence of the microbe of hog cholera, even had the animal suffered from the disease, would be extremely small in specimens collected and sent as these were. The expenditure in time and materials would also probably amount to several times the value of the hog.

Very truly yours,
F. F. WESBROOK.
Director.

March 21, 1901, Mr. R., of New Ulm, telephoned Dr. Wesbrook at the laboratory stating that he had seen Mr. S. the day before and that Mr. S.'s desire was to know whether the meat was fit for sale. That the original letter was written by his son and was worded as it was through a desire to admit that the meat had been killed for food purposes. Mr. R. was told that such an examination would cost the state in time, material, etc., several times the value of the hog. He said he appreciated the situation, and that he would write Mr. S. that it did not seem necessary to spend so much when so little was at stake. Growing out of this promise of Mr. R. to write to Mr. S., the following letter was received:

New Ulm, Minn., March 27, 1901.

F. F. Wesbrook, M. D., Minneapolis, Minn.

Dear Sir: Having had a conservation with Mr. C. L. R., who a few days ago interviewed you in regard to the meat I shipped you, and after having him explain to me what time and labor it would require to ascertain the desired result, we concluded to drop the matter, there being a dispute over one animal only.

Thanking you for your information and time you have given me in this matter, I am,

Respectfully yours,
C. S.

Beef—*Hastings.*—On March 23, 1901, there was received in the laboratory by U. S. Ex. Co., a package accompanied by the following letter:

Hastings, Minn., March 22, 1901.

Dear Dr. Wesbrook: You will receive by express a specimen of beef upon which you will kindly express an opinion.

A certain butcher killed a beef and sold the hind quarter to a Mr. K., who requested me to have it examined. The meat, although killed not over twelve hours, had a blackish appearance. Furthermore, it is known that a heifer died and was sold to the same butcher for the hide. Mr. K. fears that the butcher may have sold him a part of the heifer that died, and hence does not feel at liberty to use the meat unless satisfied that it is fit food.

All the specimens I can get is a piece of adductor muscles of thigh and a kidney. Neither can I state what caused the death of the heifer.

Respectfully,
H. VAN BEECK.

P. S. I do not know whether or not you are the proper person to send the specimen to. If not, will you please forward it, at my expense, to its proper destination.

The package contained a kidney and a piece of muscle. Further than the bluish or purplish appearance of the kidney mentioned in the letter, microscopically there was nothing apparently wrong. Cultures were made from the kidney, the outside of which was sterilized by means of heat immediately after its receipt. These showed no development of bacteria. Even had they done so, it would not have shown that the meat was necessarily unfit for food, in consideration of the fact that the specimens had been in transit for some hours without any means of preventing the development of bacteria which might have gained access to them. It was possible that the purplish appearance of the meat, which was not conspicuous in the part received in the laboratory and may have disappeared owing to free access of oxygen, was due to the fact that the animal was not bled or that it may have been asphyxiated. The small portion of meat was too small, in consideration of its method of sending, to be worth while investigating from a bacteriological standpoint.

Meat—*Green Isle.*—March 31, 1902, there was received in the laboratory a specimen of meat accompanied by the following letter:

March 30, 1902.

Dear Sirs: Herewith, you will please find what I believe to be diseased meat. If it is customary for the State Board to report on such specimens, I would like to hear from you in reference to this. A few hours after taking a meal at which this meat was used, a whole family was taken down with what I diagnosed ptomaine poisoning.

There was violent vomiting and purging, rapid and weak pulse and elevation of temperature. The temperature ranged from 100 to 103. This happened on the 28th inst. and they are all in a very poor condition at this writing. I could attribute their trouble to nothing else than eating this meat. This trouble happened in the township of Young America, Carver county, of which township W. B. is health officer. If you make a report you will do me a favor by sending the report to me, as the health officer does not live in this village.

J. J. LANGFORD, M. D.

Nearly the whole portion of the meat was fed to an animal in order to determine first of all whether it was poisonous or not. The remaining portion was used for making cultures which gave negative results. A large portion of the meat was incubated in broth for 48 hours. The culture was first filtered and the filtrate used for inoculating intraperitoneally guinea pig No. 523, weight 205 grammes, on the 26th of April, 1902. Four days later, April

30th, the animal was dead. The rectum was prolapsed. There was no increase in the amount of peritoneal fluid. The spleen was slightly swollen and congested. The liver was slightly swollen, but of normal color. Kidneys were congested. The bladder was distended. The gall bladder was enormously distended.

Direct coverslip preparations from the peritoneal fluid, liver and gall bladder, stained with eosin and methylene blue, showed no micro-organisms. Cultures in broth and on serum from the same localities remained sterile after 48 hours' incubation. There seemed to be no evidence obtainable by laboratory methods that the meat had been responsible for the symptoms in the people who had eaten it.

Ham and Cheese—*Arlington.*—April 26, 1902, there was received in the laboratory specimens of ham and cheese from Arlington, Minn., accompanied by the following letter:

Arlington, Minn., April 24, 1902.

Dr. F. F. Wesbrook, Minneapolis, Minn.

Dear Doctor: I have cases here in the village that I suspect to be results of some kind of food intoxication. About a week ago, two children of one family, five and eight years respectively, took sick suddenly with vomiting—fever, 102-103, pulse, 120-140. Abdominal pain and purging. The stools consist of mucous particles, blood and fluid. These two children are gradually improving. Day before yesterday the older boy took sick, exactly the same way. His age is 12 years, and to-day the oldest girl, age 14. Now all the children in this family are sick with the trouble. I diagnosed it gastro-enteritis and believe it to be of toxic origin. I have investigated the food they have been eating, and I found this ham. They have been eating from it raw. Also the cheese. Please examine the same, and let me know as soon as possible. The ham was sent in here from some packing house.

Yours fraternally,
C. W. KANNE.

The cheese and meat were both in the same package and in contact with each other in such a manner as to readily permit the contamination of one by the other. Portions of the cheese were fed to mice and they ate it greedily without the production of any symptoms. Cultures were made from both the meat and cheese and after 48 hours in the incubator an exceedingly abundant growth of a motile bacillus was present, apparently unmixed with other micro-organisms. This was morphologically and culturally *B. coli communis.* Cultures from both sources, *i. e.,* cheese and meat were inoculated intraperitoneally into guinea pigs Nos. 524-525 respectively, which died in less than 18 hours. The organism was recovered

in pure culture and the previous diagnosis of *B. coli communis* was corroborated.

In order to determine the presence of a toxine in the original material, an aqueous extract was made from the meat and another from the cheese. These were filtered through a Berkfeld filter in order to remove the bacteria, and the filtrate was inoculated intraperitoneally in 1 c. c. doses into guinea pigs Nos. 526-527 respectively. These animals showed no symptoms during the ensuing month, and were thereafter used for another purpose. There was thus no evidence of the presence of any considerable amount of ptomaine present in the original material. It is possible that the strain of *B. coli communis* found in both specimens may have been virulent to man and may have been responsible for the symptoms.

Pork—*Le Roy.*—Jan. 2, 1903, there was received from Dr. M. J. Hart, of Le Roy, Minn., a specimen of pork for examination. Specimen consisted of a portion of the spinal column about five inches long, apparently from the lumbar region, with the attached dorsal muscles and skin. One mass of muscles extending through the specimen was necrotic and a large part of this space was filled with cheesey pus. Direct coverslip preparations and cultures in broth on agar and serum all showed only streptococci.

Lard—*Hawley, Minn.*—Feb. 2, 1903, there was received in the laboratory some small pieces of lard and muscle contained in one of the laboratory diphtheria test tubes. February 3rd, the following letter was received concerning the specimens:

Hawley, Minn., Feb. 2, 1903.

Dr. Wesbrook, University of Minnesota, Minneapolis, Minn.

Find specimens (lard and muscle) which we would like to have examined in regard to whether the hog was diseased or not. We are acting on advice of local board of health and a veterinarian. Report by mail results.

D. & A.

The pieces of meat received were not large enough to make a satisfactory examination. The matter was explained to D. & A. with a request for further data and larger specimens. Nothing further was heard from them.

Pasteurized Milk—Aug. 11, 1902, at 5 p. m., there was brought to the laboratory by the secretary of the State Board of Health, one glass jar of Pastuerized milk which had been bought in the market in St. Paul.

Two gelatin plates were sown with 0.002 c. c. each and two with 0.1 c. c. each of the milk from this jar. The latter two plates showed growth entirely too thick to count the colonies, and the gelatin was liquefied after 60 hours at 21° C. The former plates (sown with 0.002 c. c.), gave 990,500 and 835,000 colonies respectively. An average of these two gave 912,750 colonies per c. c. It is worthy of note that the neck of the milk specimen bottle was slightly chipped and a space left between the paper cap and the neck.

Aug. 19, 1902, another bottle of Pasteurized milk was brought to the laboratory by the Secretary of the State Board of Health. This bottle of milk had been purchased in open market in St. Paul.

Gelatin plates containing 1 c. c., 0.05 c. c. and 0.02 c. c. of the milk were sown. These plates were kept in the culture closet for 48 hours and then counted. The average showed 19,120 colonies per c. c. of the milk.

Bitter Milk—*Long Prairie, Todd Co.*—Feb. 5, 1903, Dr. Annand visited the place of Mr. R. A. L., of Long Prairie, Todd Co., and collected specimens of milk from a cow belonging to Mr. R. A. L. Mr. L. in a letter requested the examination of the milk and said concerning it: "The milk has been used all the time in my family, but in small quantities. We use the cream in coffee and on breakfast foods and use little of the milk. The milk does not taste bad until after it has stood a day or a day and a half. We therefore have used little of it and thrown the rest away. I do not think it has affected any of the family. There seems to be something wrong with the cow, and I think best that the milk be examined in order that I may know that it is not harmful."

Dr. Annand's notes were as follows:

"This cow was giving bitter milk and the owner wished to obtain the reason for it. She was a Jersey cow nine years old. Present owner has had her about two years. The bitterness of the milk was first noticed about 18 months ago, and four months before calving. The animal was dried up and the calf was dropped in November. The milk was all right until the following February. It was not noticed to be bitter until April. The cow was then turned into grass, but the milk remained bitter until the middle of May. The owner then dried the cow up. She calved again about the 20th of October, 1902. The bitterness began about December 1st and was still present when the specimens were taken, Feb. 5, 1903. Cow came from Iowa three years ago. She had been fed good wild hay, bran and peelings. She was in apparently good health. The surroundings were good. The

milk was kept in the pantry in winter and in the cellar in the summer, with good surroundings. Mr. W. E. L., father of Mr. R. A. L., took some of the milk from this cow to his place in May and June, 1902, and kept it in the refrigerator. The milk was still very bitter there. The bitterness seemed to vary at times. The animal had salt in her manger, and in January had been given one pound of Epsom salts and had the dose repeated on the second day with no apparent change in the milk.

I took a milking from this cow after preparing her in the following manner:—The cow's udder and teats were sterilized by being washed with a 1.1000 bichloride solution. The udder was then covered with a piece of gauze sterilized in bichloride solution and having four holes cut for the teats to project through. My hands were then sterilized, and into sterilized bottle No. 1 a portion of the first milk from all four teats was milked; into sterilized bottle No. 2 specimens of the second milk from all four teats were collected; into sterilized bottle No. 3 the last milkings of all four teats were collected. Into sterilized bottle No. 4 was placed a specimen of milk (from an earthen crock) which had been milked the day previously by Mr. L. The specimens were collected on the morning of February 5th and brought to the laboratory at 5 p. m. of the same day."

Bottles Nos. 1-2-3 and 4 noted in the above report by Dr. Annand, when received in the laboratory at 5 p. m., Feb. 5, 1903, were placed immediately in the ice chest and the following morning plates of agar were made by using 1 c. c. and .01 c. c. of milk from each bottle.

Cultures were made from each bottle by placing 1 c. c. of milk into a tube of broth. This was shaken up and sown into a second tube of broth with a large loop, and streakings were made onto serum and agar from this second dilute broth. At this time the milk in bottle No. 4 had a penetrating bitter taste. The milk from bottles Nos. 1-2-3 was sweet.

The milk in bottle No. 2 was divided into three parts. The first part was placed in a sterile flask and placed in the ice chest. This milk remained sweet for nine days and no peculiar taste was noticed at any time. The second portion was shaken up with an excess of chloroform. The third portion was steamed in the autoclave for 10 minutes.

Cultures from bottle No. 2 showed a white staphylococcus.

Cultures from bottle No. 3 showed a white and a yellow staphylococcus.

Cultures from bottle No. 4 showed a white staphylococcus and an evenly staining, rod-shaped, non-motile bacillus, which formed a thick ropy mass in broth, but no pellicle. Did not coagulate nor redden litmus milk. Plain milk was not made bitter by the growth in it of the organism. Formed a white moist growth with very slight reddening on litmus dextrose, saccharose and maltose agars. Formed the same white moist growth on lactose agar, but decolorized the agar. Formed white moist colonies on serum.

It is apparent from the above that the bitterness was not in the milk when drawn from the cow, but that it was produced by the growth of some organism which got in from outside, either from the air or the receptacles.

Milk—*Herman, Grant Co.*—Feb. 14, 1903, there was received in the laboratory through the Secretary of the State Board of Health, a specimen of milk accompanied by the following letter:

Dear Sir: Have to-day sent you by mail, a four-ounce bottle of milk. Please report the condition of same as soon as possible, and oblige,

E. E. H.

A second letter from Mr. H., dated February 16th, says: "I want this milk examined regarding poison or other affects that might be in said milk, and not from a sanitary point. The milk in question has a peculiar taste." A third letter received from Mr. H., February 19th, said: "The taste of the milk I cannot describe, only it is a taste that is not right. I felt no evil effects after drinking the milk, but never took over a few swallows. The cream seems to be all right when in coffee or used otherwise. The surroundings where the cow is kept could not be better." It was suggested to Mr. H. that the development of the taste might be only a temporary matter, possibly related to the manner of storing the milk or probably a slight oversight on the part of the person whose duty it was to thoroughly cleanse the receptacles in which it was contained. He was requested, in case the change in taste continued and the matter became serious, to communicate with the Department with the idea that some one might be sent to make an examination of the milk. No further communication has, however, been received from Mr. H.

Milk—*Mountain Lake, Cottonwood Co.*—April 9, 1903, there was brought to the laboratory by Dr. Brimhall, a pint beer bottle filled

with milk which had been collected on April 5th on the farm of Mr. S., near Mountain Lake, Minn.

This milk had been collected by Mr. S. without aseptic precautions, and brought in for examination to determine, if possible, the cause of the bitter taste in it.

One c. c. of this milk was taken with a pipette and sowed into broth, and from the broth streakings were made onto agar and serum.

Cultures showed a streptococcus, a large white staphylococcus, a small rod-shaped bacillus which coagulated and decolorized litmus milk and grows with an abundant orange yellow growth upon all solid media. Also a very small motile bacillus which forms a heavy pellicle in broth, which later sinks to the bottom of the tube; a moist growth on serum, which is of the same color as the serum; a moist growth upon all litmus agars, which are slightly alkalinized; does not coagulate litmus milk and alkalinizes it slightly; does not form indol. This bacillus is not identical with the bacillus found in the bitter milk obtained on the farm of Mr. L., Long Prairie, Minn.

* * * * * * * *

The most obvious lesson to be drawn from the above account of these sundry examinations of meat, milk, etc., is the necessity for the proper selection, collection and transmission of specimens. Many of the specimens above described were absolutely useless for the purpose for which they were sent, because they came from the wrong source. Most of them were improperly collected and improperly packed for shipment. Not infrequently very much more time is wasted in the laboratory in attempting to determine something from erroneously collected and shipped material than would be required to send a man to the locality to investigate and collect specimens in the proper manner.

DIPHTHERIA (?) IN CAT.

St. Paul, Minn.—Sept. 6, 1901, there was received from Dr. Richard Price, St. Paul, a specimen consisting of a culture on serum with the swab with which it was taken from the tongue of the cat, the property of Dr. K. B., St. Paul. Specimen had been taken August 31st, but was brought to the laboratory by Dr. Price September 6th. A heavy, pasty growth already existed on the serum which was partially liquefied. Fresh cultures were sown from the swab and from the serum in broth and on fresh serum.

After 24 hours in the incubator, a heavy growth in all of the cultures appeared. A mixture of bacteria consisting of staphylococci, very short colon-like bacilli and large spore-bearing bacilli were present on microscopic examination. After 48 hours in the incubator, the serum in all the tubes was beginning to be liquefied. Since the culture had been six days collected before it was placed in the incubator, and since such a large admixture of bacteria was present without any forms resembling *B. diphtheriæ,* no further sub-cultures or study of the micro-organisms was made.

RABIES.

Introductory.—Up to Jan. 1, 1901, specimens from 51 supposedly rabid animals had been received and examined in the laboratory. These have all been reported in the reports of this board for 1895-98 and 1899-1900. An analytical report of the first twenty cases was presented at the American Public Health Association, Oct. 29, 1897. Further notes on these twenty cases and the succeeding twenty-six cases were also published in the St. Paul Medical Journal, August, 1900.

In addition to the above reported cases occurring prior to 1901, on Dec. 11, 1901, the following information concerning another large outbreak was received:

Outbreak 39A—*Fridley, Anoka Co.* (*Cattle*).—March 12, 1900. A number of cattle in a herd of 140 belonging to Mr. L. H. Hoyt were bitten by a strange dog. Between two and three weeks afterward the cattle began to develop symptoms of rabies and *sixty-five* died or were killed during the ensuing six months.

From Jan. 1, 1901, up to the present date, May 1, 1903, specimens have been examined in the laboratory from 41 cases of supposed rabies.

The following contains a detailed report of these cases and information concerning certain others:

Outbreak 45—*St. Paul, Ramsey Co.* (*Dog*)—*Lab. No.* 52.—Jan. 18, 1901, Dr. Richard Price of St. Paul, sent to the laboratory a small pug dog which was in the paralytic stage of rabies. This animal was a case which had occurred near Olive street in St. Paul. It was exhibited to the class in pathology and bacteriology in the Medical Department of the University. On the morning of January 19th the dog was found dead. Rabbits 416-417 were inoculated therefrom and died in 20 and 16 days respectively after exhibiting symptoms of rabies.

March 1, 1901, information was received from Dr. Price that two other dogs, the property of Mrs. C., St. Paul, had been bitten by the above mentioned dog and were, at that time, showing symptoms of rabies. One of these, a terrier, had shown symptoms about the middle of February and disappeared permanently. The second, a setter, was shot when symptoms were well developed.

Outbreak 46—Faribault, Rice Co. (Swine)—Lab. No. 53.—Feb. 28, 1901, there was received in the laboratory from Dr. L. Hay, of Faribault, Minn., the head of a hog, accompanied by the following letter:

I send you this day, per U. S. Express, a specimen of a hog's head which was shot by its owner because of suspected rabies. The history of the case is as follows:

"About three weeks ago, some unknown animal, wolf or dog judging from the tracks in the snow, visited the yard belonging to Mr. A. C., and killed a number of chickens without carrying any away. Last Friday night the owner noticed that one of his hogs commenced to exhibit all the symptoms of rabies. Saturday morning he was getting worse, confirming the diagnosis of rabies. He was shot by the owner in the forenoon of the same day after having inflicted wounds on every hog in the pen."

L. HAY.

Two series of rabbits were inoculated with material from this case, Nos. 418-19 and 422-23, and died after exhibiting symptoms of rabies.

Under date of March 28, 1901, Dr. Hay gave the further information that Mr. A. C. had one other hog which had been destroyed after exhibiting symptoms similar to those exhibited by the one noted above.

Outbreak 47 (?)—St. Anthony Park, Ramsey Co. (Dog)—Lab. No. 54.—Feb. 28, 1901, there was received in the laboratory from Dr. M. H. Reynolds, of the State Experiment Station, St. Anthony Park, Minn., the head of a dog, accompanied by the following history:

"The animal had been bitten 10 days previously by a strange dog. Feb. 27th he was first seen by Dr. Reynolds and then seemed to be paralyzed. He died Feb. 28th, and the head was removed and sent to the laboratory."

Cultures from the medulla showed encapsulated, Gram-staining diplococci and short bacilli. Rabbits Nos. 420-21 were inoculated from the material and died in four days after exhibiting symptoms of meningitis. At autopsy, diplococcus pneumoniæ (?) was found in direct coverslip preparations and cultures.

Outbreak 48—Iona, Murray Co. (Dog)—Lab. No. 55.—April 15, 1901, there was received in the laboratory a dog's head from Dr. L. A. Williams, of Iona Lake, Minn., accompanied by the following letter:

March 25, a strange dog came to the house, looked wild and ran around biting at everything. It bit two other dogs, several head of cattle and some swine. This dog was killed April 7th. The jaw of dog designated No. 1

was found bitten and swollen. The animal could not close its mouth, and tried to bite and eat but could not. It was tied up and continued restless until April 10th, when it died. April 8th, dog designated No. 2, four months old, was noticed acting unnatural and cross. It bit the other dogs. It ran away April 9th and came back April 10th. April 10th it was lying on the floor when a man dropped a handkerchief a few feet from him. The dog jumped at him, lacerating three small places on the back of the hand so that blood flowed. The dog was tied up. April 11th it acted cross and would attempt to bite anyone that went near him. Would also bite at a stick. Continued to eat until the afternoon of April 12th; then refused food; became more quiet and was found dead, but still warm, on the morning of April 13th. What would be your advice to patient in regard to going to the Pasteur Institute?

L. A. WILLIAMS, M. D.

Advice was given to send the patient to a Pasteur Institute without awaiting a laboratory report. Two series of rabbits were inoculated, Nos. 425-26 and Nos. 428-39. These all died in periods of from 15 to 30 days after exhibiting symptoms of rabies.

Outbreak 49—*Minneapolis, Hennepin Co.* (*Man*)—*Lab. No.* 56.—May 7, 1901, Dr. Wilson collected specimens from a case of rabies occurring in the practice of Dr. R. A. Campbell, Minneapolis, Minn. The case gave the following history:

Saturday, April 20th, F. H., nine years of age, was playing in his father's yard in South Minneapolis, when a strange dog ran into the yard, attacked and bit him at the base of the right thumb nail and over the metacarpo-phalangeal joint of the forefinger of the right hand. The wounds were but slight ones. They were washed with water into which a small amount of carbolic acid had been placed, healed rapidly and the incident was almost forgotten. The dog was not seen again by anyone in the neighborhood.

Saturday evening, May 4th, two weeks after the bite, the child was excited, slightly feverish and drank a great deal of water. By the following (Sunday) morning, he appeared to have some difficulty in swallowing. Dr. Campbell was called about noon Sunday. He found the child with slightly increased temperature, but apparently well and rational, except a constant desire to drink and an inability to do so on account of spasm or slight convulsion when attempting to swallow fluids of any kind. Dr. G. D. Head was called in consultation Monday afternoon, May 6th, and found the same symptoms, but somewhat exaggerated, the child going into a marked spasm whenever it attempted to drink. He was still perfectly rational and objected to trying to drink fluids, because, as he said, "it made him want to lie down." (He had not been talked with by any

one, except at the time of the bite, concerning the bite and, presumably, knew nothing of the symptoms of rabies). Spasms were readily excited Monday evening whenever anyone entered the room. They grew rapidly worse during the night, and the child died about 2 a. m., May 7th. About 2:30 a. m., i. e., about 30 minutes after death, the body was injected with over one and one-half pints of 15 per cent formalin, that is, 6 per cent formaldehyde solution, by an undertaker. The undertaker said that at the time he made the injection the body was in the most intense rigor mortis. He succeeded in getting a very perfect injection, as was evidenced at autopsy.

Autopsy at 9:30 a. m., May 7th, seven and one-half hours after death. Body was that of a slender, poorly nourished, eight or nine year old, male child. Two slight scars were found; one at the root of the nail of the right thumb and the other over the metacarpophalangeal articulation of the right forefinger. In opening the abdominal cavity, a very strong odor of formaldehyde was present. The liver, stomach and intestines were bleached and hardened by the solution. Otherwise, all the organs were apparently perfectly normal in size and shape. No evidences of inflammation. A slight puckering was present at the apex of the left lung and at the base of the right lung was a small amount of hypostatic congestion. The heart, anteriorly, was markedly affected by the formaldehyde solution. (Undertaker said that he had succeeded in getting a complete circulation of the fluid).

The brain was markedly hardened by the formaldehyde solution, except the posterior temporal lobes, which did not appear to be much affected. (The cranium had been injected by means of a trochar thrust into the fourth ventricle.) The interior of all the ventricles of the brain was well hardened; the medulla and upper cord markedly so. The brain and five or six inches of the upper end of the cord were removed and brought to the laboratory. The base of the skull containing the proximal portions of the cranial nerves was chiseled out and brought to the laboratory. All the specimens were placed in 10 per cent formalin with 33 per cent alcohol, after inoculation material had been selected.

An emulsion was made from the white matter apparently least exposed to formalin in the interior of the posterior temporal region, and rabbits Nos. 426-427 inoculated therewith at 3 p. m., May 7th, 1901. These animals died in eight and seventeen days respectively after inoculation, after having exhibited symptoms of rabies. A

second series, rabbits Nos. 432-33 were also inoculated and died after exhibiting symptoms of rabies.

This case is of particular interest not only because of its occurring in man, but further because of the fact that the virus of rabies was unchanged by a very thorough embalming by formaldehyde, seven hours before the collection of the specimens.

Outbreak 50 (*?*)—*South St. Paul, Dakota Co.* (*Dog*)—*Lab. No.* 57.—May 17, 1901, at 7 p. m., Dr. Annand brought to Dr. Wilson's house, the head of a dog wrapped in paper, of which he gave the following history:

The dog, on the morning of May 17th, was seen to be acting strangely near the stockyards in South St. Paul. He was shot by a policeman, skinned and thrown into a rendering vat. Sometime in the afternoon, Health Officer C. G. Lytle had the carcass removed from the vat, the head severed from the body, wrapped in paper and given to Dr. Annand to bring to the laboratory. The head was kept in the ice chest until the morning of May 18th, when it was brought to the laboratory and examined. The head was that of a medium-sized dog, probably about 30 to 40 pounds in weight, had been skinned and was much decomposed for so short a time after death (24 hours), possibly due to the action of materials in the rendering vat noted above. A portion of the medulla was removed in as cleanly a manner as possible, an emulsion made and rabbits 430 and 431 inoculated therefrom. These animals were found dead the next morning.

Cultures in broth and on serum from the inoculation material after 24 hours in the incubator showed abundant growth of large, non-motile spore-bearing bacilli, small motile bacilli and staphylococci. Serum liquified. Owing to the decomposed condition of the material it was impossible to make a diagnosis.

Outbreak 51—*Minneapolis, Hennepin Co.* (*Dog*).—May 20, 1901, Dr. Annand examined a dog, the property of Mr. G. O., northeast Minneapolis, and found it exhibiting unmistakable symptoms of rabies. The animal had been bitten by a cur, which was afterwards killed for his strange actions about two months previously. The dog was killed, but no specimens were collected.

Outbreak 52—*St. Paul Park, Dakota Co.* (*Dog*)—*Lab. No.* 58.—June 8, 1901, there was received in the laboratory, from A. H. F., of St. Paul Park, the body of a small puppy which had been killed after exhibiting symptoms of rabies. The puppy had been bitten on May 19th by a dog which also bit several other dogs in the same vicinity. All the bitten dogs were kept tied.

Rabbits Nos. 434-35 were inoculated subdurally with this material and died in 15 and 21 days respectively. A second series, Nos. 444-45 were inoculated from this material and died after 11 and 30 days respectively. The case was diagnosed rabies.

Outbreak 53—New Canada, Ramsey Co. (Dog).—Aug. 13, 1901, Mr. Pomplun visited the place of Mr. B. K., New Canada Township, Ramsey County, to investigate a case of supposed rabies. He found that a dog, the property of Mr. B. K., had been bitten by a supposedly mad dog about two weeks before. He ordered the dog tied up awaiting developments.

Aug. 17, 1901, Mr. Pomplun again visited Mr. K.'s farm and found that in the interval the dog had become morose, refused food, snapped at everything in reach and had been killed by his owner a few minutes before Mr. Pomplun's arrival.

Minneapolis, Hennepin County (Horse)—Laboratory No. 59.—Aug. 14, 1901, there was received in the laboratory the head of a mare from Dr. C. C. Lyford. The animal had been exhibiting symptoms of rabies for three days before her death.

Rabbits Nos. 446-47 were inoculated with material from the specimen and died after 19 and 18 days respectively, having shown symptoms of rabies. A second series of rabbits, Nos. 450-51 were inoculated from these and died after 17 and 15 days respectively. The case was diagnosed rabies.

Outbreak 54—St. Paul, Ramsey Co. (Dog)—Lab. No. 60.—Aug. 30, 1901, Mr. C. N., of St. Paul, brought to the laboratory in a basket two rabbits, one small white one dead. The other, a gray rabbit, not dead, but almost so. When removed from the basket the latter rabbit showed faint twitching of the face muscles and very slight twitching of the fore paws; completely paralyzed otherwise; hind limbs were extended and the head retracted. Accompanying the rabbits was the following letter:

The bearer, Mr. C. N., has two rabbits that I have inoculated from his bull terrier that bit him August 4th and was destroyed in a dying condition August 9th. On August 10th, I inoculated these two rabbits from the cervical spinal cord of the dog. Yesterday, August 29th, the brown rabbit became paralyzed and the white one showed peculiar ungainly hind action especially in the left leg. This morning at 8:30 A. M., the white one died, paralyzed. As some one has told him and his friends that rabies does not exist only in my mind, I have told him to submit them to you as impartial judges and make inoculations to set the matter at rest. Mr. N. has taken the Pasteur treatment and wishes to know if he has done so unnecessarily.

RICHARD PRICE.

Outbreak 55—*State Experiment Station, Ramsey Co.* (*Cow*)—*Lab. No.* 61.—Sept. 27, 1901, there was received in the laboratory at 3 p. m., the head of a cow. Ten minutes later Dr. Lyford telephoned the following history of the case:

Yesterday, September 26th, the cow, a young black Holstein, at the State Experiment Station, which had been running in pasture during the summer with other cattle, began to show symptoms of craziness. She butted at the attendants, other cows, chickens, etc. Considerable escape of fluid from the mouth was present and the animal appeared weak, especially in the fore legs. She was noticed eating unusual articles, such as acorns, rugs, etc. She died about 11 a. m., Sept. 27th, not having been seen by a veterinarian. At 11:30 Dr. Lyford made an autopsy on the body. He found all of the organs normal, the central nervous system not being examined. The stomach contained numerous foreign bodies, such as a snake, several rags, pieces of rug, blanket, acorns, sticks, etc., etc. Some very dark mucous was found in the large intestine. The specimen as received in the laboratory consisted of the skin, head and upper portion of the neck of a cow, several lengths of intestine tied off, containing dark, liquid fæces.

Direct coverslip preparations, cultures in broth and on serum were made from the meninges. A portion of the medulla was used for inoculating rabbits Nos. 454-455. These animals remained alive and well during the ensuing three months, after which time they were used for another purpose.

A diagnosis of rabies was not warranted from the laboratory examination.

Outbreak 56—*Harrison Twp., Kandiyohi Co.* (*Dog*)—*Lab. No.* 62.—Oct. 21, 1901, there was received in the laboratory a brain and a portion of the spinal cord of a dog, accompanied by the following letter:

I send you by express the brain and cervical portion of the spinal cord of a dog. This dog was suspected of having rabies. The dog was not known to belong to anyone hereabouts. Had never been seen by anyone around here before to my knowledge. He came to the farm of Mr. J. N., in Harrison township, about 1 o'clock, October 20th, and attacked the poultry. As soon as Mrs. N., fho was alone on the farm, went out doors the dog at once attacked her, lacerating her hand severely. The dog persisted in the attack until finally Mrs. N. got hold of an ax and dispatched the dog by a blow on the head. The dog presented evidences of a recent encounter with a skunk. It was a female hunting dog of some kind. I have removed the

specimens, I regret to say, not under the strictest aseptic precautions, but the jar was thoroughly sterilized and the specimens placed in glycerine.

F. M. ARCHIBALD, M. D.

From the specimens rabbits Nos. 458-459 were inoculated and died in 77 and 21 days respectively, having exhibited symptoms of rabies.

Dr. Archibald's letter was answered immediately upon the receipt of the specimens and advice given that the patient be sent to a Pasteur Institute. Under date of October 23rd, he said:

I thoroughly cauterized the wounds on the lady's hands and cleaned them as well as possible. They are doing very well. She is not at all alarmed about the probability of hydrophobia and I do not think she could be induced to go to Chicago for the Pasteur treatment unless the results of the inoculations are positive. F. M. ARCHIBALD.

From rabbit No. 459, rabbits Nos. 463-64 were inoculated and died after 45 and 25 days respectively. From rabbit No. 463, rabbits Nos. 528-29 were inoculated and died after 22 and 21 days respectively. All of these animals exhibited symptoms of rabies before death. The long period of incubation in rabbit No. 458 may have been due to the fact that the material had been preserved for some time in glycerine before it was inoculated.

Jan. 2, 1902, a statement of the results of the inoculations up to that time was again made to Dr. Archibald. Under date of Jan. 4, 1902, he wrote:

The wounds on Mrs. N.'s hand healed in the course of a week or ten days and she has had no symptoms since except some numbness in one finger that was injured the worst. She is gradually recovering from that. Doubtless this was due to the injury of a nerve. Mrs. N. is not particularly inclined to borrow any trouble about the matter. I spoke to her and her husband about going to Chicago for the Pasteur treatment, but she did not care to go.

On Feb. 27, 1902, Dr. Archibald was informed of the final result of the laboratory investigation, i. e., that the case was certainly rabies. No further information was received in the laboratory concerning this case.

Outbreak 57—*Taunton, Lyon Co.* (*Steer*)—*Lab. No.* 63.—Oct. 29, 1901, Drs. Brimhall and Wilson visited the farm of Mr. H. P., three-quarters of a mile west of the town of Taunton, Minn., examined, killed and made an autopsy on the body of a steer, the sixth in

a herd exhibiting similar symptoms. The following history of the outbreak was obtained:

About September 20th a bitch on the place, which had been apparently sick for two or three days, was noticed to be covered with the odor of skunk. During the day she seemed morose, somewhat cross and was seen to bite a horse and a spring calf. On the evening of the same day she was tied up and shot. The owner thought nothing more of the matter until Friday, October 18th, when a yearling heifer was noticed by the herd boy to be acting crazy. The heifer would run rapidly for a short distance and then drop down upon her belly. After lying a few minutes she would rise and walk about as though nothing had occurred until another "running" spell took her. Occasionally she would stop and bawl furiously.

Twenty-four hours later a two-year-old steer became similarly affected. Both would rush at the owner or any moving object and attempt to butt it with the forehead. The animals occasionally stuck their noses into the dirt and tried to eat it. They seemed to have difficulty in swallowing, especially fluids. The heifer died after three days' illness and the steer was killed at the same time that he might be buried in the same hole. During the week of October 20th to 26th, four more cattle, from calves to three-year-olds, became affected. One of these died after four days' illness, two were killed by the owner and the sixth, which became sick October 26th, was killed by the writers October 29th for purposes of autopsy. When seen by the writers, the animal was in a shed and bawling almost constantly. Occasionally he would make a wild rush across the shed over manger or against posts or walls, as though insane. Usually such a rush ended by the animal dropping to the ground as though shot. A large amount of foamy saliva was dropping from the mouth. The eyes had a wild staring expression. Temperature 103.6°. The animal was killed and an autopsy made at once. No lesions whatever of any of the organs were found except in the central nervous system. Here extra-durally at the base of the cranial cavity and surrounding the pituitary body was found a small, dark red clot. Some injection of the vessels of the pia was present over the entire surface of the brain, especially over the posterior lobes of the cerebrum. A very large amount of fluid, straw colored and clear, was present subdurally and within the ventricles of the brain. Direct coverslip preparations and broth and serum cultures were taken from the lung, spleen, heart's blood, brain substance and serum of ventricles of the brain.

Direct coverslip preparations stained with eosin and methylene blue in the laboratory, showed no bacteria. All cultures remained sterile except one of two serum tubes sown from the brain substance. This showed two colonies slightly yellowish in color and consisting of large bacilli. Two broth tubes from the same place gave no growth. It is probable, therefore, that these two colonies were a contamination, an accident which might readily have happened since the autopsy was made in a shed which had recently been strewn with fresh hay.

A portion of the medulla removed with aseptic precautions was used for inoculating rabbits Nos. 460 and 461. These two rabbits both died after 20 days, having shown symptoms of rabies. From one of them, a second series of rabbits, Nos. 465-66, were inoculated and died after 18 and 17 days respectively, having shown symptoms of rabies.

Under date of Nov. 4, 1901, information was received from Mr. J. that two more cattle had shown symptoms similar to those exhibited by the other animals and that one had died and he had killed the other.

November 25th, Mr. J. lost another cow with the disease. The head of this animal was shipped to the laboratory, where it was received Nov. 27, 1901. It was listed as case No. 66. Rabbits Nos. 474-75 were inoculated with material therefrom and died in 20 and 23 days respectively after exhibiting symptoms of rabies. From one of these a second series of rabbits, Nos. 488-89 were inoculated and died after 35 and 17 days respectively, having exhibited symptoms of rabies before death.

On Nov. 30, 1901, information was received from Mr. J. that some days previously his large, black Newfoundland dog had acted strangely, and in order to avoid trouble the animal was killed immediately.

It will be seen from the above that in this outbreak nine head of cattle and two dogs were affected with rabies.

Outbreak 58—*Bloomington, Hennepin Co.—Case No.* 64 (*Dog*).—On the morning of November 21st, Dr. A. A. Keys, V. S. of the Department of Health, Minneapolis, telephoned the laboratory that the carcass of a supposedly rabid dog, which had bitten some people and several animals in Bloomington Township, Hennepin County, had been left at his office through misunderstanding.

On the afternoon of November 21st Dr. Wesbrook visited Bloomington and Richfield and saw Mr. W. A. Harrison, C. B. S., of Bloom-

ington, Minn., J. A. D., of Bloomington, Mr. A. D., a near neighbor of Mr. J. A. D., and the postmasters at Bloomington and Richfield. From these sources and Dr. Keys and from numerous letters, the following information was obtained:

On the afternoon of November 19th, at 4 p. m., a rather large-sized yellowish to brown, stoutly built dog attacked Mr. H. W. P., who lives close to the Minnesota river, about two miles east of Bloomington P. O. The dog approached Mr. P. from behind and inflicted wounds on the outer aspect of the left thigh and punctured the back of the right. His right hand was very badly lacerated, the end of one finger being almost destroyed. (See below—notes of Dr. J. Clark Stewart, Minneapolis.)

A dog answering this description was next seen at 5 p. m. of the same day by E. R. P. and J. B. on Lyndale avenue, about midway between Richfield and Bloomington, where it attacked dogs belonging to Mr. S., Mr. F. B. and P. C., and acted in a peculiar way in other regards. At 8:30 the same evening, after dark, a large dog, from description apparently the same one, appeared at the house of Mr. A. D. Something worrying the house dog and making a noise over his food pan attracted the attention of Mr. D.'s son, F., aged 17, who, in going out to drive away, as he supposed, a neighbor's dog, was attacked, thrown down and very severely bitten in the left leg and the left thumb. (See below—notes of Dr. J. H. Stuart, Minneapolis.)

Fifteen minutes later, as Miss M. L. D. stepped from the door of her father's (J. I. D.'s) house, she was set upon, knocked down and very severely bitten on the left thigh. (See below—notes of Dr. J. A. Crosby, Minneapolis.)

The next morning about 9 o'clock the dog was first seen by school children west of Mr. R. M. B.'s house (P. O. address, Bloomington Ferry), which is about five miles west of Mr. D.'s residence. Soon after the dog had been seen by the children, Mrs. B. saw it in the yard with the cattle, where it lay down until approached by the cattle, when it invariably jumped up and chased them. Mrs. B. drove it from the yard, but it chased her into the house. The dog immediately turned upon some little pigs in the door yard and Mrs. B. opened the door and threw the broom at it. The dog caught and chewed the broom. At 10 o'clock this same morning (November 20th) the dog was shot by Mr. S. at Mrs. B.'s request and the carcass was brought to Dr. Keys, V. S., Minneapolis, by J. A. D. of Bloomington, on the morning of November 21st.

Mr. W. A. Harrison, C. B. S., of Bloomington, visited Mr. B. and furnished a portion of the above history. He states that he could not find any of the cattle which showed evidence of having been bitten, nor did Mrs. B. see them bitten. One colt had a scratch on the side of the head.

Route followed by the dog.—November 19th, 4 p. m., seen two miles east of Bloomington (attacked Mr. P.). At 5 p. m., same day, midway between Bloomington and Richfield, i. e., five miles N.E. of Mr. P.'s place, where it bit several dogs and two people before 9 p. m.; 9. a. m., Novmber 20th, five miles west from where it was observed the night before.

List of people and animals bitten by the dog.—People.—Mr. H. F. P., Bloomington P. O., November 19th, 4 p. m.; F. D. and Miss M. L. D., between 8:30 and 8:45 p. m., November 19, 1901.

Dogs.—Dogs belonging to Mr. S., Mr. F. B. and Mr. C. and Mr. A. D.

Other animals.—Several small pigs, possibly one colt and perhaps some of the cattle belonging to Mr. R. M. B.

Precautionary Measures and Procedures—Human Beings.—Mr. H. F. P. and Miss D. were sent to Dr. Lagorio's Pasteur Institute, Chicago, on the night of November 20th, and F. D. was taken there on the following evening by Dr. J. H. Stuart. Concerning local treatment, nature of wounds, etc., see notes below for information kindly afforded by Drs. J. Clark Stewart, J. H. Stuart and J. A. Crosby.

Animals.—Dr. Wesbrook advised Mr. W. A. Harrison, C. B. S., to see that all dogs and cats which had been bitten be destroyed; that pigs be confined and that horses, cattle and other animals be closely watched for the development of symptoms. In the case of cows, it was suggested that should any develop strange symptoms, the owner's should be warned against using the milk.

Of the four dogs bitten those belonging to Mr. A. D. and Mr. P. C. were killed. All other dogs in the neighborhood were chained up, including the two bitten animals belonging to Mr. S. and Mr. B.

Origin of the supposedly rabid dog.—Nothing further than given in this history can be ascertained. Mr. W. A. Harrison investigated the rumor concerning the possible identity of this animal with a stray dog reported to have been seen in the neighborhood of Bloomington P. O. some days previous to the biting. Mr. Harrison took a good deal of trouble in supplying and verifying information, and promised to forward a complete list of any animals in the neigh-

borhood which developed any symptoms of rabies or any other information which might bear upon this case.

Notes from physicians who attended the bitten people.—In response to letters the following information concerning these cases has been kindly afforded:

"Your note of inquiry regarding Miss D. is just at hand. Her injuries were several deep punctured wounds of both the inner and outer aspect of the thigh just above the knee, as if the dog had grasped the part between his jaws. There was some laceration of the skin in one place. The friends had "sucked" out the wounds before my arrival. My treatment was simply a thorough cleansing with a strong bichloride solution and a dressing of iodoform gauze and cotton held in place with a bandage.

(Signed) J. A. CROSBY."

"Your favor making inquiries concerning the wounds of young D., who was bitten by a dog is before me. His left thumb was pierced and slit in three or four places and the nail was torn off—pretty badly injured. There were a number of tooth marks on his left thigh from region of knee up to middle portion—one on inner aspect short distance above the knee was deep and large as a 'nickel.' A slit in the skin on outer aspect an inch or more long. The rest were less serious, several in number, ranging from scratches and bruises to punctures of the skin. They were all made aseptic with formaldehyde and dressed with iodoform gauze. When redressed in Chicago they were free from pus and healing rapidly. I went with the boy to Chicago, and placed him in the care of Dr. Lagorio of the Pasteur Institute, where the other two were located or were under treatment.

(Signed) J. H. STUART."

"Right third finger was chewed off just at base of nail. On left thigh, four inches above knee to outer side was a 1½-inch long gash down to fascia. On outer side of right thigh were two tooth punctures with a good deal of extravasated blood. Wounds had been washed with carbolic solution 1½ hours before I saw them. I cleaned them thoroughly with two per cent formalin and dressed them with sublimate gauze. We then had no knowledge of dog's condition, but I told Mr. P. to hunt up dog at once and if there was any evidence of rabies to go at once to Pasteur's Institute.

(Signed) J. C. STEWART."

Laboratory Notes.—There was received in the laboratory at 2 p. m., Nov. 21, 1901, the body of a large yellowish to brownish dog, evidently part shepherd (weight approximately 75 pounds), which had been shot through the left eye and through the thorax. Owing to the time which had elapsed since the killing of the dog and the pressure of other work, a complete autopsy was not performed. A portion of the medulla was taken by severing the head from the body

through the cervical vertebræ. Two rabbits, No. 467, weight 1,915 grammes, and No. 468, weight 1,540 grammes, were inoculated subdurally with .2 c.c. of an emulsion of the medulla in sterile bouillon. These two rabbits died in 22 and 19 days respectively after showing symptoms of rabies, and a diagnosis of rabies was transmitted to the Chairman of the Board of Supervisors of Bloomington on December 12th.

Confirmation of the laboratory diagnosis by later information relative to animals bitten by the rabid dog on November 19th and 20th.

Further information was obtained during January from Mr. Harrison, C. B. S.

Dogs.—1. A dog belonging to Mr. D., which was not supposed to have been bitten, was kept chained, showed symptoms on December 9th, and was shot on the same day by Mr. R. D., who lives about three miles S.W. of Mr. D.'s. The dog had broken the chain and run away.

2. The dog belonging to Mr. B. showed symptoms of rabies on December 8th, and was shot by him.

3. The dog belonging to Mr. H. K., which he thought had been bitten by Mr. D.'s dog, was shot.

4. A dog, owner unknown, was shot by Mr. O.

Other Animals.—1. A pig died 19 days after having been bitten.

2. Cows, two heifers. The date of the death of one is given as exactly two months after having been bitten. The date of the development of symptoms and the death of the other animals is not given, though the symptoms were noted as having persisted for 48 hours, and at the end of 36 hours paralysis occurred.

3. Horses. One three-year-old colt showed symptoms of rabies after having been bitten and died 20 hours later.

Summary.—A dog shown to have been rabid both by laboratory examination and by the subsequent history of bitten animals, bit three people, none of whom developed symptoms of rabies. They had, however, received immediate local treatment and Pasteur treatment was begun within two or three days after the injury.

2. A number of animals bitten by this dog developed symptoms of rabies. These included two dogs, one pig, two heifers and one colt. A number of other animals were destroyed on suspicion.

3. It would seem that it is unsafe to rely upon the owners of the bitten dogs to see that they are properly secured and kept in confinement. A number of letters were written relative to this mat-

ter and the destruction of the dogs known or suspected to have been bitten was urged. Notwithstanding this, one of the dogs, which was supposed to be securely confined, developed rabies, escaped and was shot three miles from his home.

4. The necessity for vigorous protective measures is well shown by the history of this case.

5. Incidentally, the efficacy of the Pasteur treatment is illustrated.

Outbreak 59—*St. Paul, Ramsey Co.* (*Dog*)—*Lab. No.* 65.—Nov. 26, 1901, Mrs. T., owner of the dog in this case, brought to the laboratory a kidney and the head of a Cocker spaniel. From the brain, Dr. Price of, St. Paul, had already inoculated two rabbits subdurally. These rabbits were also brought to the laboratory. Accompanying the specimen was the following letter:

The animal is a black Cocker spaniel, five months old. It was bitten by a mongrel cur about three months ago. This dog, a terrier, at the same time killed some cats and developed a snappish disposition. He fought with other dogs in the neighborhood and was killed by the owner on account of his aggressiveness. The Cocker spaniel first began acting strangely in the forenoon of Nov. 14, 1901, by seeking consolation and petting more than usual, so much so as to cause the owner to remark on it. He next chased some chickens, biting the tail feathers off two. Later he crossed the street and killed one chicken after a general attack upon the flock. The lady owning the chickens noticed the dog chasing them and called his mistress. She drove her dog away, but he returned again to the attack of the fowls. Mrs. T. punished him, when he suddenly ran at the lady owning the chickens, jumped at her and attempted to bite her. He was carried home by his mistress and shut in the barn. During this time he either bit or scraped Mrs. T. on the hand between the thumb and first finger. That evening Mr. T. found the dog in the barn acting snappish. Suspecting rabies, he attempted to catch the dog by the collar with a rake. The dog snapped at the implement, and the collar breaking the owner lassoed him until he could slip on a muzzle. The next evening the dog was brought to my infirmary, where he evidenced his snappish disposition. At all times he was silent except when aggravated and attacking an object repeatedly. He made no sound nor evidenced any sign of pain when struck. He ate and drank up to the day previous to his death. He tore his bedding, took the basin containing the drinking water in his mouth, spilled the water and "worried" the basin. He snapped at any object presented to him until the last day, when he appeared indifferent and semi-paralytic. He died November 25th at about noon, that is eleven and one-half days after his first restlessness was noticed. On the whole, the dog showed the usual characteristic symptoms of furious rabies, and the fact of his having been bitten by a supposedly rabid dog strengthens the diagnosis of rabies. The objection to this diagnosis is the long period of nearly twelve days between the onset of symptoms and his death. R. PRICE.

The head of the spaniel when received in the laboratory had had the skull removed (by Dr. Price) and the upper surface of the brain was macerated. Cultures were made from the medulla and direct coverslip preparations were taken from the meninges at the base of the brain. About two inches of the spinal cord was removed with the dura intact. This portion of the cord was used for inoculating rabbits Nos. 472-73. The direct coverslip preparations from the meninges at the base of the brain showed a Gram-staining diplococcus. It was also present in broth cultures from the medulla as well as a staphylococcus.

The two rabbits which had been previously inoculated by Dr. Price were kept in the laboratory and died in 19 and 21 days respectively. At autopsy both rabbits showed congestion of the meninges. Direct coverslip preparations from the meninges, heart's blood, lungs and liver showed no bacteria. Cultures from the same sources showed no bacteria except one culture from the lung of rabbit B, which showed short bacilli. From rabbit A of this series, the second series, rabbits Nos. 482-83 were inoculated. Rabbit No. 482 showed no symptoms during the ensuing three months and was then used for another purpose. Rabbit No. 483 died after 10 days. At autopsy the left pleural cavity was found coated with thick, viscid, yellow pus. Cultures showed staphylococci present.

Rabbits Nos. 472-73 inoculated in the laboratory from the spinal cord of the dog died in 21 and 23 days respectively.

In addition to the above subdural inoculations for rabies, rabbits Nos. 492-493-496 and 530 were inoculated intravenously with various cultures of the bacteria obtained from the rabbits noted above. In none of these were any symptoms produced.

This case is of peculiar interest owing to the prolonged period (eleven and one-half days) which elapsed between the appearance of what seemed to be the initial symptoms of rabies and the death of the animal. Out of six animals inoculated from this material in two series, all of the first series (four) died in the usual time and after exhibiting the usual symptoms of rabies. Of the two rabbits in the second series, one died of empyema at the end of 10 days and the other remained alive. Notwithstanding this unsatisfactory feature of the investigation a diagnosis of rabies must be given in consideration of both clinical and laboratory data.

Outbreak 60—Anoka, Anoka Co. (Cow)—Lab. No. 67.—Dec. 8, 1901, Drs. Brimhall and Wilson visited the farm of Mr. G., eight miles north of Anoka, Minn., and killed and made an autopsy on the body of an animal of which the following is a history:

On the morning of Nov. 16, 1901, a large black and tan shepherd dog, the property of Mr. G., was observed to be acting queerly. He appeared excitable and easily irritated. A little later he began chasing the cows, several of which he was seen to bite. He then attacked the hogs in the pen and bit several of them. A three-year-old child of Mr. G.'s attempted to drive the dog from the house with a club and was aided by his mother. The dog appeared to be perfectly obedient when he was made to hear and made no attempt to bite the people. In the evening when Mr. G. returned home, the dog met him, but gave no evidence of recognizing him, an unusual occurrence. While Mr. G. was unhitching his team, the dog thrust his nose up against Mr. G.'s leg as though attempting to bite him, but seemed unable to do so. During the night the dog disappeared and has not since been heard of.

November 27th, 12 days after the episode of the dog, a cow became sick and died in 48 hours. The animal seemed at first excited, but rapidly became paralyzed in the posterior extremities and died apparently in great agony. From this time until December 8th, that is, 11 days, two yearling calves and four pigs died with symptoms consisting essentially of an initial period of excitement followed by a period of paralysis. The eighth animal, a cow, had been sick for three days when seen December 8th. She appeared excited, attempting to butt chickens, turkeys, etc., when they came near her. A rather thick, tenacious saliva escaped from the mouth; made no attempt to drink when water was placed before her and when walking exhibited marked symptoms of inco-ordination. The rectal sphincter was apparently paralyzed.

The animal was killed by bleeding and the central nervous system examined. There was marked congestion of the meninges, especially at the base of the brain, where the tissues surrounding the pituitary body was infiltrated with a blood clot (?) closely resembling that observed in Taunton animal (rabies case No. 63).

Cultures were made from the meninges; and the cortical portion of the right frontal lobe of the cerebellum was preserved in 96 per cent alcohol.

A similar portion from the left side was collected in a sterile Petri capsule and a portion of the medulla was collected in a sterile flask, brought to the laboratory and used for inoculating rabbits Nos. 478-79. These two animals died in 20 and 21 days respectively after exhibiting symptoms of rabies. From rabbit No. 478, a second series of rabbits, Nos. 497 and 498, were inoculated. These also died of rabies.

Outbreak 61—*Minneapolis* (*Dog*).—Dec. 9, Dr. Annand was called to treat a dog in S. E. Minneapolis, and found the dog in a paralytic stage of rabies. A police officer destroyed him.

Outbreak 62—*Fridley* (*Dog*)—*Case No.* 68.—Dec. 8, 1901, a mongrel dog, the property of O. P., Fridley, Minn., was noticed by the hired man acting queerly. Dog left home on the night of Dec. 8th and bit several dogs in the neighborhood. Monday, December 9th, at about 10 a. m., dog attacked and bit a two-year-old heifer, the property of Mr. T. D. K. The dog was then shot.

The dog was brought to the laboratory Dec. 11, 1901, at 5 p. m., by Messrs. L. H. H. and T. D. K., of Fridley, Minn.

Examination of dog next morning at 9:30 showed that he had been killed by shooting with both rifle and shot gun. The skull had been fractured and the brain substance macerated. The head was cut off by sawing between the axis and atlas, the end of the cord flamed, a portion of the medulla removed and placed in a sterile dish. Direct coverslip preparations and cultures from the medulla showed no bacteria. Rabbits Nos. 480-481 were inoculated with an emulsion made from sterile broth and a portion of the medulla. These rabbits died in 20 and 17 days respectively after showing symptoms of rabies. From rabbit No. 481 a second series, rabbits Nos. 499 and 500, were inoculated. These died in 19 and 21 days respectively of rabies.

Outbreak 62 *Cont'd*—*Fridley* (*Dog*)—*Case No.* 69.—Saturday, Dec. 14, 1901, the head of a shepherd dog was brought to the laboratory by Mr. L. H. H., of Fridley, Minn. This dog belonged to W. S. He said it had been bitten by O. P.'s dog (Laboratory case No. 68). which developed rabies on Dec. 8, 1901. The S. dog had been kept chained since bitten and is known not to have bitten any animals or persons. On December 13th the dog attempted to bite the persons feeding it and on suspicion of having rabies was shot.

The head was placed out of doors and kept frozen until Dec. 16th, 1901, when the neck was sawed off near the head, the cord and surrounding tissues cauterized and a portion of the medulla removed. An emulsion was made from this and two rabbits, Nos. 480-81 inoculated subdurally.

These animals showed no symptoms during the ensuing eight months, after which time they were used for another purpose.

Mr. H. was communicated with on January 29th and February 26th, and it was pointed out that presumably in this dog which had

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*Biennial Report 1899-1900, page 576.

been bitten only five days before it was killed, rabies virus had not yet time to develop and be present in its nervous system. This view of the case still holds. It is perhaps of some importance when considered in the light of former work done in this laboratory* in which it was shown that after subdural inoculation of fixed rabies virus, it was possible to demonstrate its presence in the central nervous system of the inoculated animal at any time from the date of inoculation until the appearance of symptoms and death of the animal from rabies.

Outbreak 63—*Porter* (*Dog*).—Dec. 17, 1901, Mr. L. I. Leland, Chairman Board of Supervisors, Porter, Minn., reported to this board that a dog in the township of which he was chairman had "gone crazy, killed some neighbor's chickens and when he came home again bit a puppy and a calf. The owner tried to kill him, but the dog left home and was not seen again."

The owner had been going past Mr. J.'s place near Taunton (see rabies cases No. 63 and No. 66) and the dog may have been bitten by Mr. J.'s dog. Mr. Leland was requested to report any further developments of cases in his township, but nothing more was heard from him. From the history, it would appear that the case was probably one of rabies.

Outbreak 64—*Merriam Park* (*Hog*)—*Lab. No.* 70.—Mr. J. L., Route 1, Merriam Park, Minn., brought to the laboratory on Dec. 26, 1901, the head of a pig which had been removed a few hours before, when it had been found dead. The hog on the previous day had shown loss of appetite and a tendency to retire into corners, snapping its jaws and "foaming" at the mouth. A history of the hog having been bitten by a dog on December 7th was given.

From the medulla of the hog, two rabbits, Nos. 494-95, were inoculated. These succumbed in 22 and 14 days respectively. From rabbit No. 494 two other rabbits, Nos. 508-509, were inoculated on Jan. 18th. Rabbit No. 508 developed pneumonia (both lungs) and to relieve its suffering was killed on February 10th. Rabbit No. 509 was still alive and apparently well at the end of eight months, when it was used for another puropse.

A positive diagnosis of rabies was transmitted to Dr. Brimhall on February 1st, owing to the findings in the first pair of rabbits inoculated, the second pair being alive at that time.

In view of the fact that of the two rabbits of the second series, one showed diplococci at autopsy and the other remained alive and well for eight months, it is possible that this diagnosis of rabies was not

*See Biennial Report Minn. State B'd of Health, 1899-1900, page 576.

warranted, and that the case may have been originally one of meningitis. It should, however, be mentioned that no bacteria were demonstrated in the original material from the hog's brain. The case illustrates the desirability of inoculating more than one series of animals and awaiting the results of such inoculations before giving a positive diagnosis in doubtful cases.

Outbreak 65—Minneapolis, Hennepin Co. (Cow) Lab. No. 71.—Dr. C. C. Lyford brought to the laboratory Feb. 3, 1902, at 4:30 p. m., the head of a heifer, the property of Mr. A. R. T., a dairyman, who lives just above Shingle Creek on the River road, Minneapolis. Dr. Lyford gave the following history:

"Mr. T. first noticed in the morning when he started out that a pup (about eight months old) which belonged to him, began to jump and run after the cows and catch them by the tail. He could not call him off, or make him stop, so he caught him and gave him a whipping. The dog followed Mr. T. to the horse barn. On opening the door, the dog caught a chicken, shook her and broke her neck. He whipped him again and as soon as he let him go, he ran around the barn and ran after some young cattle in the adjoining yard, when he is supposed to have bitten this heifer. Mr. T. knew that he had caught some of them by the tails, but did not know whether it was this one. This was about six or eight weeks ago. Mr. T. then called the dog to the house and while Mr. T. was sitting at breakfast, the dog began to howl and make a good deal of noise. As soon as Mr. T. got breakfast he went down town and did not get back until noon. Mrs. T. says the dog continued to howl until about 10 a. m., when he started up the road. He next went to the first neighbor's and killed about six chickens; the next place he went he got into the pig pen and bit some of the pigs; the next place he went he killed several ducks. Here the woman shut him up in an outhouse with one of the ducks and waited until her husband got home when he killed the dog by shooting."

Mr. T. telephoned Dr. Lyford that prior to that time they had a tramp dog that had killed several chickens and bit other dogs. He knew the dog in question was bitten. The tramp dog was killed when he began to show signs of being ugly. This was about the latter part of July or 1st of August, 1901.

"The heifer was paralyzed behind; could raise herself probably a foot from the ground and could only carry herself for five or six feet at a time. Heifer would start to bellow and hurry up as fast as she could; she would then fall and straighten out and have a

sort of spasm, bellowing for three or four minutes. She looked wild. She would not drink water and had not eaten anything for a couple of days. On the morning she was taken ill, she was running around the yard lame and weak behind, but could walk. By night she became so paralyzed that she could not rise or move in any way. She had paralysis of the bladder; and could not pass urine. There was a good deal of straining. Every 10 to 15 minutes she would have one of those bellowing spells." Dr. Lyford saw animal on Jan. 30th, at 1:30 p. m. She died on Friday night, Jan. 31, 1902.

Head was put in ice chest until morning of Feb. 4th. Two rabbits, Nos. 518-519, were inoculated subdurally with an emulsion of medulla from the head.

Under date of March 20, 1902, Mr. A. R. T. communicated the following further information: "Another one of my milch cows came down with the disease (rabies) the early part of this week and died yesterday having shown symptoms of rabies for only about two days. I had both the heifer and the cow cremated at the crematory at the workhouse, which is a mile south of my farm."

The first pair of rabbits inoculated from the heifer in this case, namely Nos. 518-519, died in 17 and 20 days respectively after having shown symptoms of rabies. A second series, rabbits Nos. 526-527 were inoculated from rabbit No. 518 and died after 63 and 68 days respectively. A diagnosis of rabies was made in the case.

Outbreak 66—*Belle Plaine, Scott Co.* (*Dog*)—*Lab. No.* 72.—Feb. 19, 1902, there was received in the laboratory, an express package which had been addressed to the State Experiment Station. After telephoning the Station, the box was opened in the laboratory and it was found to contain a small yellow dog and the following note:

Belle Plaine.

To be examined for rabies. This dog and three others were bitten by a strange dog three weeks ago. All three showed typical symptoms of rabies, and have died after being sick 48 hours.

DR. F. J. BOHLAND-FUCHS.

From the medulla of the dog, two rabbits Nos. 524-525 were inoculated subdurally. These animals developed symptoms of rabies and died in 29 and 23 days respectively. From the medulla of rabbit No. 525, rabbits Nos. 532-533 were inoculated subdurally. Of these, rabbit No. 533 succumbed to rabies in 23 days. Rabbit No. 532 showed no symptoms during the ensuing six months, after which time it was used for another purpose.

Dr. Bohland-Fuchs was asked for further information concerning this outbreak on two occasions, but none was received from him.

Outbreak 67—*Fridley, Anoka Co.* (*Dog*).—Feb. 26, 1902, Mr. L. H. Hoyt, Town Clerk of Fridley, Minn., brought to the laboratory the head of a dog. Mr. Hoyt gave the following history:

Feb. 24th at 10:30 a. m., a strange dog, gaunt in appearance and having an uncertain gait, was observed passing through the town of Fridley. He was seen to fight and probably to bite two dogs. He passed on across the river to the town of Brooklyn Center, where he fought with and probably bit two dogs, the property of Mr. C. H. J., near Osseo. The dog was followed from Fridley by Mr. Hoyt and several other citizens. Shortly after he attacked Mr. J.'s dogs he was shot through the head. The brain was much torn to pieces by the shot. The head was removed from the body and brought to the laboratory by Mr. Hoyt, who reported that the two dogs above noted in the town of Fridley, were already muzzled and would be kept muzzled or confined for some months unless they in the meantime showed symptoms of rabies.

On examination in the laboratory, the brain of the dog was found to be so completely destroyed that it was impossible to obtain material for inoculation.

Outbreak (?) 68—*Howard Lake, Wright Co. (Cow)—Lab. No.* 73.—March 13, 1902, there was received in the laboratory a bottle of milk from Howard Lake, Minn., accompanied by the following data:

In another package, you will find a sample of milk from a cow that is supposed to have been bitten by a mad dog 16 days ago. She has attacks of being restless with loud bellowing. She looks all right aside from that. She eats and drinks as usual after the attacks.

A. G. MOFFATT, M. D., H. O.

Rabbits Nos. 534-535 were inoculated subdurally with a portion of the milk received. They showed no symptoms during the ensuing three months.

A telephone message received from Dr. Moffatt several weeks later said that the cow had recovered. The case was evidently, then, not rabies.

Outbreak 69—*Oronoco, Olmsted Co.* (*Hog*).—March 14, 1902, there was received in the laboratory, the brain of a hog from Oronoco, Minn., accompanied by the following letter:

I am a butcher here and have some hogs that are ready to kill. We had a mad dog here that bit a number of cattle and hogs. I lost a sow that was about to pig. She got too much feed. I will send the brain for examination to see if I may kill the others. F. A. C.

The specimen when received was in an ordinary fruit jar, completely putrified and in a semi-fluid condition. It was therefore impossible to make any inoculations. It would appear from Mr. C.'s letter that the animal was not suffering from rabies. It is mentioned here only because of its possible connection with the next case.

Outbreak 69 *Cont'd—Oronoco, Olmsted Co.* (*Dog*)—*Lab. No.* 74. —March 24, 1902, there was received in the laboratory, the head of a small mongrel dog, wrapped in oil cloth and packed in sawdust, from Mr. E. J. Rice, Town Clerk, Oronoco Twp., Oronoco, Minn. On request, Mr. Rice gave the following information concerning the case:

"The dog's head sent you was the one which appeared in this vicinity January 27th, the origin of which is unknown. I cannot say positively if this dog was killed January 28th or 29th. During the interval between January 27th and the time it was killed, the dog bit a number of animals on places in this vicinity. After the dog was killed, the body froze very quickly and remained frozen until it was sent to you. Twenty days after being bitten by this dog a two-year-old heifer belonging to Mr. F. W., of Oronoco. began to act strangely. It would strike at any one coming near and it frothed at the mouth. Finally it was killed. Another animal, a yearling belonging to Mr. J. L., of Oronoco, had been bitten by a dog about January 27th. About 30 days later this animal showed symptoms similar to those in the heifer. It ate nothing, broke all boxes and boards within reach and was killed about eight days after first being noticed. Still another animal belonging to Mr. J. L. acted the same after about 40 days. It was killed four days after becoming sick. All of these cattle were buried. The hog belonging to Mr. F. C., of Oronoco (see previous case) was affected similar to the above animals about 35 days after the dog was known to be in this vicinity. It was not known, however, that the dog had been near the hog. The hog was killed and the head sent to you for examination."

Under date of April 4, Mr. Rice again wrote: "No other cases of rabies have broken out since those previously reported."

From the medulla of the dog mentioned above, two rabbits, Nos. 536-537, were inoculated subdurally. One of these, No. 536, died in 19 days after having exhibited symptoms of rabies and the other,

No. 537, showed no symptoms during the ensuing six months, after which time it was used for another purpose. A second series of rabbits, Nos. 546-547, were inoculated from rabbit No. 536. Rabbit No. 546 died after 23 days, of rabies. Rabbit No. 545 showed no symptoms during the ensuing six months.

Though two of the inoculated animals in this case failed to die of rabies, there can be little doubt that the dog from which the material was obtained had been suffering from this disease when killed. The failure to obtain positive results with all of the rabbits may have been due to the fact that the material had been frozen for 55 days before it was used for inoculation.

Outbreak 70—*Cannon Falls, Goodhue Co.* (*Dog*)—*Lab. No.* 75.—March 31, 1902, there was received in the laboratory from Cannon Falls, Minn., the head of a dog accompanied by the following history:

This dog bit a boy yesterday. The dog came into the yard and the boy, L. F., tried to drive him away. He bit the boy on the hand and then ran after the cows and bit at one but she kicked him over. A girl in the family threw a stone at him and he tried to bite her, but she got out of his way. He then went to a neighbor's. The man was at the barn and the dog attempted to bite him. The man knocked him over with a club. He then went to another neighbor's and went into the barn. They tried to drive him away but he would not go. He was still there this morning. He seemed stupid and sick, but did not attempt to bite. He had no spasms. They killed him and skinned and buried him. When it was reported to me. I told Mr. F., whose son had been bitten, to get the head and I would send it to you for diagnosis.

H. E. CONLEY, M. D., H. O.

From the medulla of the dog noted above, rabbits Nos. 539-540 were inoculated subdurally. These died after 24 ad 25 days respectively, having shown symptoms of rabies. From the medulla of rabbit No. 539, a second series was inoculated, Nos. 553-554. These also died after 30 and 23 days respectively, having shown symptoms of rabies.

The boy, L. F., who had been bitten by the dog noted above, was sent to the Pasteur Institute at Chicago, where he was given the Pasteur treatment. He developed no symptoms of rabies.

Outbreak 71—*Arlington, Sibley Co.* (*Dog*)—*Lab. No.* 76.—April 8, 1902, there was received in the laboratory, the head of a dog accompanied by the following letter from Arlington, Minn.:

Send you by U. S. Express, head and neck of a dog who died sometime Sunday night, April 6th. Did not see the dog, but have been informed that he bit three children and that one of them left for Chicago this afternoon to

take treatment. Saw one of the children yesterday that was bitten Friday of last week. There were two small wounds but healed. During Friday and Saturday of last week, dog was cross to other dogs and Saturday afternoon he left home. The owner of the dog can give no information as to whether the dog showed any signs of rabies or not.

(Signed) M. E. BUSHEY, M. D., H. O.

In another communication dated April 15th, Dr. Bushey says:

Referring to rabies case No. 76, would say that the name of the owner of the dog is Wm. S. His son was bitten in the hand and no treatment was used until the fourth day. There was just a slight abrasion of the skin. I saw the hand on the fourth day and cauterized the wound and applied only collodion dressing. A Mr. H. and his son were also bitten, the man on the foot and the boy on the hand. A son of Mr. T. S. was bitten on the hand. I can learn nothing in regard to other dogs being bitten by this one. When he went out into the country, a large black dog belonging to a farmer caught this dog which was a small one across the neck and hurt him internally as was shown by the post-mortem examination. Mr. S. took his son to Chicago for treatment. The H.'s. so far as I know, did nothing to the bites.

(Signed) M. E. BUSHEY.

The head of the dog when received in the laboratory was packed in a tin pail, without ice, but was in fairly good condition. From the medulla of the dog in this case, rabbits Nos. 543-544, were inoculated subdurally, and died after 20 and 19 days respectively, having shown symptoms of rabies. A second series of rabbits, Nos. 556-557, were inoculated subdurally from the medulla of rabbit No. 543. These died after 48 and 25 days respectively, having shown symptoms of rabies. From rabbit No. 556, which had lived 48 days after its inoculation, a third series of rabbits were inoculated, Nos. 571-572. Rabbit No. 571 died on the day following the inoculation. At autopsy, a general œdema with a large amount of fluid in the peritoneal, pericardial and pleural cavities was found. Rabbit No. 572 died after 23 days, having shown symptoms of rabies.

Outbreak 72—Sand Creek, Scott Co. (Cattle, Swine, Dogs and Goats).—April 17, 1902, Mr. Peter Poetz, chairman of the local board of health, of Sand Creek Twp., Scott Co., reported to the Veterinary Department of the State Board of Health that on the farm of Mr. E. H., 10 hogs had died and six were sick at the time. Mr. Poetz said he thought the hogs were suffering with "some kind of hog diphtheria." and that he had put up a hog cholera notice temporarily, though there were no symptoms of hog cholera. He gave an indefinite history of the hogs having been bitten by a mad dog some time before.

Under date of April 19, 1902, Mr. Gottlieb Piere, chairman of the local board of health, of Jordan, Minn., also reported a similar disease among hogs on the farm of Mr. H. K.

The above reports were a long time in reaching the State Board of Health, but immediately upon their receipt, Dr. Annand was sent, April 30th, to investigate the disease. The facts collected were as follows:

"About Feb. 20, 1902, a supposedly mad dog passed through this section of country. He is supposed to have bitten dogs belonging to Mr. O. H., of Louisville Twp.; Mr. C. F., of Jordan; Wm. D., T. B. and J. H., of Sand Creek Twp., Scott Co. He bit a number of hogs and other stock on the places of Mr. E. H. and Mr. H. K., who lived seven miles apart in Sand Creek Twp. The dog was killed on the place of Mr. K. On the farm of Mr. E. H., two hogs died about two weeks after the visit of the dog. Both of them showed the violent, excitable symptoms of a rabid animal. Eight other hogs died between March 10th and April 17th. All of them were violent for a short time, but exhibited the symptoms of the so-called dumb form of rabies more markedly.

On the farm of Mr. K., the dog had bitten two goats, one steer, one bull and seven pigs. The first to show symptoms was a she goat, which began to act strangely on March 17th and was killed by the owner on March 19th. One pig on the 21st of March "went crazy" and was killed on March 22d. One pig showed symptoms on March 22nd and died on March 23rd. One pig showed symptoms March 23rd and was killed on the same day. One pig showed symptoms on March 27th and was killed on the same day. One sow showed symptoms on April 1st and was killed on April 2nd. Seven small pigs were suckled by this sow until April 1st at noon. None had shown any symptoms at the time of Dr. Annand's visit, April 30th. One she-goat showed symptoms April 2nd and was killed the same day. One pig showed symptoms April 2nd and was killed at once. One steer showed symptoms April 7th and was killed the same day. One sow showed symptoms April 12th and died April 14. Fourteen pigs were suckled by this sow, to April 12th at noon. All of the pigs were alive and well at the time of Dr. Annand's visit, April 30th. From the owner's description there could be no doubt that the animals had rabies. The pigs would make a barking noise, chew the pen, dig with their front feet into the ground and would bite everything that was placed in front of them. The goats would start "blatting" and then later would

run about and fight and bite any animal which came in their way. The steer attempted to bite and chase the other cattle. When the owner threw sticks and stones at the animal, it would chase them as long as they rolled. In this manner by throwing rocks ahead of the steer, the owner guided the animal into the field where he wished to bury him.

Outbreak 73—Brooten, Stearns Co. (Dog).—Under date of April 24, 1902, Dr. W. S. Leach, H. O., of Brooten, Minn.. wrote to this Board as follows:

Has the village board of health power to order a chained-up dog to be killed, the said dog having been bitten by a supposedly rabid dog. A large St. Bernard dog in this place about ten days ago went mad and bit four other dogs and then attacked its master. All of the dogs have been killed except one, the owner of which refuses to kill or muzzle him. It is kept at home tied with a rope.

The requested information was given Dr. Leach and he was asked to report further developments. Nothing more was heard from him.

Outbreak 74—Northfield, Rice Co. (Dog)—Lab. No. 77.—May 28, 1902, there was received in the laboratory, the head of a dog from Northfield, Minn. Accompanying the specimen was the following letter:

We send you by express this afternoon, the head of a dog which died this morning. The dog had been sick since May 21st. The lady whom he bit goes to Chicago to-night for treatment. I think from the symptoms this was a case of hydrophobia. The dog passed through the stage of excitement, manifesting great nervousness, extreme restlessness and snapping at everything approaching him. He then became more quiet and in 48 hours passed into the stage of paralysis of the limbs, lower jaw, etc. The voice was changed.

E. E. BRUBAKER, M. D., H. O.

On inquiry Dr. Brubaker furnished the following additional information: "Dog had been chained up for some time before she showed symptoms of rabies. She had no opportunity of biting any other animal or dog, save the owner's dogs, one of which she bit. However, they killed both of the other dogs on the farm. Nothing is known as to how this dog became infected, as she had been chained up for some time, although the owner says that about three weeks before this dog became sick, they were aroused one night by a disturbance among the dogs. The owner went out and saw a strange dog in the yard, but did not shoot it for fear it might belong to some neighbor. The name of the woman bitten was Mrs. G. R.,

Randolph, Minn. The wound was located at the ankle of the right leg. There were several punctures of the skin in one of which the tooth penetrated to the depth of an inch or more. The other two were about one-half inch deep. The skin was broken with superficial scratches from the teeth all around the ankle. I saw the case about three and one-half or four hours after she was bitten, and cauterized the wound thoroughly with silver nitrate, both deep and superficial. The subsequent treatment consistetd in bathing the parts in 1-1000 bi-chloride solution and covering the surface with a mixture of Fuller's earth and glycerine."

Under date of August 6th, 1902, Dr. Brubaker wrote:

Mrs. R. went to Chicago for treatment and was there three weeks. She is still well. It is now 75 days since she was bitten.

From an emulsion of the medulla of the dog in this case, two rabbits, Nos. 565-566, were inoculated subdurally. These died in four and 13 days respectively. From the original material and from the tissues and central nervous system of both of this pair of rabbits, a bacillus of the colon group was obtained.

From rabbit No. 566, a second pair of rabbits were inoculated, Nos. 567-568. These rabbits died at the end of 19 days. No bacteria were obtained from the cultures in either case.

From the medulla of rabbit No. 567, a third series of rabbits, Nos. 579-580, were inoculated. One of these died after 65 days and the other exhibited no symptoms during the ensuing six months.

It will thus be seen that while the history of the symptoms in the dog were strongly indicative of rabies and both of the first pair of rabbits died after the usual incubation period of rabies in a rabbit and after having exhibited symptoms resembling rabies, yet a shadow of doubt remains in the laboratory diagnosis, owing to the indefinite results in the third series of rabbits and to the finding of bacteria in the original material and in the first series of rabbits.

Outbreak 75—*Clearwater, Wright Co.* (*Steer, Hog*).—The only information concerning this outbreak is contained in the following letter:

Clearwater, Minn., June 2, 1902.

Dr. H. M. Bracken, St. Paul, Minn.:

About a month ago I had a strange dog get among my stock. Several hogs and some cattle were bitten by him. I had the dog killed. Last week I lost one of my hogs and to-day a steer. Both of the animals that died frothed at the mouth, rolled and kicked as if in spasms and neither of them would take food or water. It lasted about two days. Is it hydrophobia?

If so, is there anything that can be done for the animals as late as this? Is there any harm in using the cow's milk? They all seem in perfect health as yet. I have a litter of pigs a week old from a sow that I saw the dog bite. Had I better take the pigs away?

(Signed) H. A. W.

Mr. W. was immediately communicated with, given the information he requested and asked to keep the Department informed of any further developments. Nothing more was heard from him.

Outbreak 76—Rogers, Hassan Twp., Hennepin Co. (Dog).—May 24, 1902, there was received from Mr. E. S. Wiggins, C. B. S., Rogers, Hassan Twp., Hennepin Co., a letter of which the following is an abstract:

"Am seeking information concerning rabies. A few days ago a dog, owner unknown, went on a raid through this neighborhood. In the course of his travels he bit a number of hogs belonging to one man. Since then the hogs have shown symptoms of being crazy or mad. The man has killed a part of them and has notified the town board through me. The dog was not killed or caught, and it is supposed that he bit several dogs in the course of his travels. What action should the township take in the matter? Can the man recover for the loss of his hogs?"

Mr. Wiggins' questions were answered and he was asked to give information concerning any further cases.

Outbreak 76 Cont'd—Rogers, Hassan Twp., Hennepin Co. (Hog).—June 10th, 1902, there was received by the Secretary of this Board, a letter of which the following is an abstract:

Five weeks ago to-day our hogs were bitten by a mad dog. Since then 22 have died with rabies. The dog was in the yard when the hired man got up in the morning. He chased the dog away without suspecting anything wrong. As soon as my husband knew of it, he arose and followed the dog's tracks (it having rained in the night) to a railroad crossing three miles away. That was the last seen of the dog.

(Signed) Mrs. T. DeM.

Mrs. DeM. was written to and asked to supply information concerning further cases. and also Mr. E. S. Wiggins, C. B. S., was again requested to report any further cases of rabies.

Under date of June 20th, Mrs. T. DeM. again wrote saying that another hog was sick.

June 21st, Dr. Brimhall visited the locality and investigated the report. The history obtained at this time was as follows:

May 4, 1902, a strange dog came into the neighborhood and on the farm of Mr. G. DeM., bit a large hog. From there he went to the farm of Mr. T. DeM., got into the yard with a herd of hogs and bit a number of them severely. The dog was seen with a number of other dogs, and most of these had been killed at the time of Dr. Brimhall's visit.

Two weeks after the appearance of the dog the hog which he bit on the farm of Mr. G. DeM. began exhibiting symptoms which, as described by the owner, were indicative of rabies. The animal died after three or four days' sickness. About the same time, the hogs on the farm of Mr. T. DeM. began to "act crazy" and exhibit the usual symptoms of rabid animals. In all on this farm, at the time of Dr. Brimhall's visit, 23 hogs of different ages had died or been killed after exhibiting symptoms of rabies. On the farm of Mr. R., residing a mile or two from Mr. T. DeM.'s place, two cows and one calf had died in the three weeks just prior to Dr. Brimhall's visit, after exhibiting symptoms of rabies. Two cows had died of apparently the same disease on the farm of Mr. A. DeM., who lived a short distance from Mr. T. DeM.

At the time of Dr. Brimhall's visit there was reported to the State Board of Health for the first time, the death of a dog belonging to Mr. D. T., near Mr. T. DeM.'s place, which had gone mad during the winter or early spring of 1902. Also the death of two dogs belonging to Mr. J. C., which were killed on account of the disease during the winter of 1902. It was also reported that two years previously, a dog went through the same vicinity and bit a number of animals, of which one cow, three calves and 11 hogs died after exhibiting symptoms of rabies.

At the time of Dr. Brimhall's visit, one hog, three months old, was sick on the farm of Mr. T. DeM. This animal was taken sick June 19, 1902. It was biting at all objects about him. It squealed almost constantly as though in pain and tried to crowd itself into small corners. The hog was killed June 21st and the head shipped to the laboratory, where it was received June 23, 1902. (Case 78). From an emulsion of the medulla of this hog, rabbits Nos. 577-578 were inoculated subdurally. Both animals died after 26 and 21 days respectively, having shown symptoms of rabies. From rabbit No. 577, a second series of rabbits were inoculated, Nos. 581-582. These animals died after 62 and 68 days respectively.

Under date of Aug. 24, 1902, Mr. T. DeM. again reported to this Board that he had lost two more hogs. One died June 25th and the other Aug. 23rd.

Under date of Sept. 18, 1902, he reported the loss of another hog, which was taken sick September 17th, thus making a loss of 26 hogs out of a herd of 31.

If the last two hogs were infected originally from the dog, the incubation period must have been 95 and 120 days respectively. If, on the other hand, they were infected from the last hog which died prior to them, the incubation periods were 59 and 84 days respectively.

Outbreak 77—Waconia, Carver Co. (Dog).—Under date of July 4, 1902, Dr. H. I. Grivelly, of Waconia, Minn., reported to this Board, a case of rabies in the following letter:

> I was called to see a boy named F. S. last Saturday. He had been severely wounded by his father's dog. The wounds were located on the lower extremity. Besides this boy, the dog had attempted to bite another child but had not wounded it. He had bitten a hog, another dog and had killed two turkeys. I found the dog chained and scratching and biting at everything in his way. He showed a general disposition to tear wood, clothing, etc., to pieces. His conjunctivæ were congested and the skin on the forehead and over the eyes wrinkled. There was no froth from the animal's mouth. He was constantly moving about, searching, scraping and barking without any object. His bark was hoarse and of a peculiar sound. I ordered them to let the dog live for further examination. On June 29th, 1902, I found the dog trembling, dull, depressed and quiet, to some extent. He had a partial paresis of the hind extremities and a swaying motion in walking. He tried to jump a fence near his home and hung thereon. To prevent further mischief, Mr. S. shot the animal.
>
> The other bitten animals were also killed and burned, together with everything around the dog's kennel.
>
> The patient was sent to Chicago for treatment for rabies.
>
> (Signed) H. I. GRIVELLY.

Nothing further was reported to the State Board of Health from this outbreak.

Outbreak 78—Blooming Prairie, Steele Co. (Dog).—Aug. 4, 1902, Dr. E. W. Cooley reported a case of rabies from Blooming Prairie, Minn., as follows:

"The first animal to show symptoms was a dog, the property of M. F., Blooming Prairie, Minn. The dog became sick July 9th. The dog constantly tried to bite people and objects. He frothed at the mouth. The animal bit his master July 11th, on which date he was killed. Mr. F. went to Chicago on July 13th to take the Pasteur treatment and returned on July 27th. He was still well on Aug. 4. 1902.

Outbreak 79—*Annandale, Wright Co.* (*Dogs, Calf*).—July 20, 1902, an apparently rabid dog visited the farms of Mr. G. W. K., Mr. A. O., Mr. M. P., Mr. H. H. and Mr. J. H. On Mr. K.'s place the dog bit the house dog. This latter animal was killed July 25, 1902.

On Mr. A. O.'s place the dog bit two dogs and a calf. The dogs were killed July 21st. The calf showed symptoms of rabies Aug. 7, 1902.

On the place of Mr. M. P., the dog bit one dog. This animal was killed July 25, 1902.

On Mr. H. H.'s place, the dog bit seven hogs and was here killed. No information has been received concerning the fate of the herd of hogs.

On Mr. J. H.'s place the dog bit one dog, which was immediately killed.

Outbreak 80—*Kiester Twp., Blue Earth Co.* (*Cattle*).—Aug. 5, 1902, Drs. Brimhall and Wesbrook went to Kiester Twp., Blue Earth Co., in answer to a telegram from Mr. W. O. Conrad, chairman of the Board of Supervisors, stating that cattle were dying of an unknown disease. They found that cattle had died with hydrophobia, one owner having lost three head in the previous three months. The last one died some days before and was buried.

Outbreak 81—*Maple Lake, Wright Co.* (*Dog*).—Under date of Aug. 15, 1902, Mr. E. A. Hart, C. B. S., of Maple Lake, Minn., reported as follows:

"A dog came through the town of Albion in July and bit several dogs and calves. Some of these have gone mad and been killed. Some have not yet gone mad, but are being watched."

Mr. Hart was asked to send a full report on the cases, but nothing further was heard from him.

Outbreak 82—*Dexter, Mower Co.* (*Cow*)—*Lab. No.* 79.—Aug. 14, 1902, Dr. Annand visited the farm of Mr. O. O., at Dexter, to investigate the cause of trouble in a herd of cattle, the property of Mr. O. A supposedly mad dog had passed through the locality about the middle of July, 1902. The dog had fought with Mr. O.'s dog. About three weeks later Mr. O.'s dog developed rabies and was shot. Two or three of the neighbors' dogs had fought with the strange dog and they also developed rabies and either had died or been killed.

On Dr. Annand's arrival, he found one animal down and unable to rise. Another animal, a steer, had evidently died from rabies.

The sick cow was killed and a post-mortem examination made at once. There were no gross lesions except general congestion of the meninges.

Specimens from the medulla of the cow were brought to the laboratory, Aug. 15, 1902, at 7 p. m., and were inoculated Aug. 16, 1902, into rabbits Nos 590-591. These two rabbits died after two and one days respectively. Cultures from the original material and also from the meninges of both rabbits gave an abundant growth of *B. coli communis* and another small bacillus.

Whilst the clinical symptoms would seem to warrant a diagnosis of rabies, a laboratory diagnosis was thus doubtful owing to contamination in the material and consequent death of the inoculated animals from bacterial infection.

Outbreak 83—*New Market, Scott Co.* (*Cattle, Dog*).—Under date of Aug. 20, 1902, Mr. N. A. Frederickson, C. B. S., of New Market Twp., Scott Co., gave to the Board the following information:

"Mr. K. K., of New Market Twp., Scott Co., lost six cows in the last few weeks, the last one 10 days ago. A mad dog was at his place some weeks before the first cattle got sick and bit his cattle."

Under date of Aug. 29, 1902, Mr. Frederickson made a formal report of the death of six cows and one dog on the farm of Mr. K. K., and gave the additional information that the dog had gone mad and bitten Mr. K. K.'s daughter and that the girl had been taken to Chicago for treatment.

On communicating with Dr. J. A. Sanford, New Market, Minn., the following information was obtained:

"About six weeks ago (August 10th) Miss K. came to my office with a dog-bite on her leg. I inquired about the dog. The symptoms as described showed rabies. The dog had bitten another little boy and several cattle and had already been shot. I advised the girl to go to Chicago and take the Pasteur treatment. Dr. Phelps, of Northfield, also gave her the same advice and she went. I advised the parents of the little boy to send him also, but he is at home and still well. I advised Mr. K. to keep his cattle confined to a yard or barn, and I am certain that he has done so."

Outbreak 84—*Shakopee, Scott Co.* (*Dog*).—Aug. 25, 1902, there was received in the laboratory a portion of the brain and spinal cord of a dog from Dr. H. O. Smith, of Shakopee, Minn. Accompanying the specimen was the following letter:

Shakopee, Minn., Aug. 22, 1902.

Dr. H. M. Bracken:

I send you by express today a section of the spinal cord and brain of a dog that created quite a stir here yesterday. The dog acted strangely and bit at least a dozen other dogs here. We finally located him and shot him. He was quite a large dog, but thin. He would attack a person as eagerly as he would another dog. The specimen is not as good as I could have wished, but it is as good as we could obtain after he was killed. Will you have it tested for rabies and let me know the results as soon as possible? I have quarantined all the dogs known to have been bitten, and have advised all persons to keep their dogs at home until we know positively whether there is any danger or not.

(Signed) H. O. SMITH, M. D., H. O.

The specimen when received in the laboratory Aug. 25, 1902, *i. e.* four days after having been removed from the animal, was so much decomposed that a laboratory examination was impossible. Dr. Smith was advised of this fact and requested to send specimens from other dogs should any become affected.

Shakopee, Scott Co. (Dog)—Lab. No. 80.—Accordingly on Sept. 10, 1902, there was received in the laboratory another specimen from Dr. Smith, accompanied by the following letter:

Shakopee, Minn, Sept. 10th, 1902.

Dear Doctor: I send you by express today the head and neck of a dog killed last evening, for examination for rabies. This dog was bitten on Aug. 21st, 1902, by the dog whose brain and spinal cord I sent you at that time and which was so decomposed before you received it that it was not fit for use. This dog has been quarantined since August 21st. He first began to get sick Sept. 6, 1902. He refused to eat or drink and appeared stiff and sore. The lips were drawn so that the teeth showed plainly. He seemed to have difficulty in swallowing and had attacks of restlessness. He seemed frightened and howled fearfully. The dog finally broke away and was shot by a policeman. I have posted a notice that all dogs must be muzzled for a period of 60 days, and have taken all the precautions that I can, but there are so many dogs that may have been bitten without anyone knowing it that it is almost impossible to quarantine all that should be under quarantine. (Signed) H. O. SMITH, M. D., H. O.

When the head was received in the laboratory it was in good condition, having been wrapped in an oil cloth, placed in a tin pail and the pail packed in ice. From the medulla of the dog, two rabbits, Nos. 594-595, were inoculated subdurally. One of these rabbits, No. 595, died at the end of 63 days without showing any symptoms of rabies. The other remained alive and well for six months, after which time it was used for another purpose.

Thus it will be seen that the laboratory diagnosis was negative, despite the typical clinical history of rabies in the dog from which the material was obtained.

Outbreak 85—Granite Lake, Wright Co. (Dog, Cattle, Etc.).— Oct. 14, 1902, Dr. E. Y. Chilton, of Howard Lake, Minn., notified this Board that rabies existed in the town of Albion, Wright Co., and requested that instructions concerning quarantine, etc., be sent to Mr. J. L., Granite Lake, Wright Co.

After communication with Mr. L., the following letter was received:

Granite Lake, Minn., Oct. 20, 1902.

About three months ago my neighbor's little dog appeared to be wild. He came to my place and began biting and fighting with my dog. The next day he was killed, after he appeared to be sick. About six weeks later my dog started to bark like the neighbor's dog. He would not eat anything. He ran after the cattle and jumped on the cat and bit it badly. His eyes were red and he foamed at the mouth a little. I killed him and the cat at once. At this same time two of my hogs also got sick. They seemed to go totally blind. One died shortly after we noticed that he was sick and the other lived three days. The hogs did not try to bite anything. About four weeks after this, or Oct. 8, 1902, one of the cows became sick. She would go by herself and lie down in the pasture. We put her in the barn and kept her there until the 12th, when we let her out with the other cattle. She ran after them and tried to hook them. She foamed at the mouth. We put her in the barn again and let her out the next morning, but again she ran after the other cattle and tried to hook them. She did not seem to feel it when she was whipped, and she would not try to hurt a person. Her eyes were a dark red. She shivered a good deal. She did not try to eat or drink anything for six days. After being almost dying for 24 hours, I killed her on the 15th. I have no more animals that are sick or that I know of being bitten. My neighbor has a dog that was supposed to have been bitten the same night that my dog was bitten, but he is running around and not stick.

Mr. M. W., of this place has just told me the following:

One day this summer a dog came to his place and jumped into the hog pen and bit two hogs badly, and one slightly. The two that were bitten badly got sick some time afterward and he killed them. The one that just got a scratch is still all right. When the dog left the hog pen he ran after a calf and bit it. The calf got sick some time afterward and foamed at the mouth. Mr. W. killed the calf. After the dog left Mr. W.'s. farm it ran on and bit several dogs along the way. It was killed at last and I understand that several dogs that this dog bit have also been killed.

Mr. H. W., of this place, says that one day this summer, a crazy dog came running and bit his dog in the nose and then ran on. Mr. W. killed his dog at once. Mr. P. N., address Smith Lake, Minn., says that one day this sum-

mer a mad dog came running and bit his two dogs. One of these got sick 17 days afterward and ran away and he has not seen him since. The other dog was not affected.

(Signed) J. L.

Outbreak 86—*Comfrey, Brown Co.* (*Cows*).—Under date of Oct. 20, 1902, Mr. O. T., of Comfrey, Brown Co., wrote to this Board a letter of which the following is an abstract:

"I have had three cows die of late. The first thing noticed is that they act mad and chase the other cattle in the yard for a day or so. After that they will lie down and get up frequently for two or three hours. After that they cannot get up any more. They then lie and kick for 15 or 18 hours and then die. The two first that died, died on the same day. After that I did not notice anything for about five weeks, when a third one died. Her bowels moved freely."

Mr. T. was asked to report by telephone or telegraph should any other of his animals become sick, that an investigation might be made. Under date of Nov. 1, 1902, he again wrote that no more of his cattle had become sick and that he should report if any did.

Outbreak 87—*Litchfield, Meeker Co.* (*Man, Horse*)—*Lab. No.* 81. —Oct. 4, 1902, there was received in the laboratory, the brain and medulla of a horse, from Litchfield, Minn. Accompanying the specimen was the following letter:

Dr. H. C. Peters, V. S. of Litchfield, Minn., sent you to-day the brain and medulla of a horse which was supposed to have died of rabies. This horse, after having been ill for about 24 hours, bit and severely injured a young man who had him in charge. The horse died in about two hours after the accident, after biting wagons, fences, posts and everything within its reach, as well as breaking his teeth by biting stones in the barn yard. Dr. Peters is of the opinion that the horse died of rabies. Please make the necessary inoculations to establish diagnosis. I have the young man in a hospital here and am very anxious to know whether the diagnosis of rabies is correct or not.

(Signed) JAS. W. ROBERTSON, M. D.

Dr. Robertson was advised immediately that it would be safer to send the patient to the Pasteur Institute without delaying to determine the results of rabbit inoculations.

Under date of Nov. 8, 1902, Dr. Robertson supplied the following additional information: "The horse that died was on a farm about one mile south of Grove City in Meeker Co. The young man's name was E. E. After he left me he became a patient of Dr. E. Boeckmann, of St. Paul. I do not know whether he was sent to Chicago or not. My advice was to send him at once, but they would not have it that way."

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Accompaying the specimen from the horse was also the following letter from Dr. H. C. Peters, V. S., Litchfield, Minn.:

I am sending you to-day part of the brain and medulla of a horse. This horse died after showing symptoms corresponding quite closely with rabies, after having bitten its attendant. Dr. Robertson, the physician having the case in charge, wishes a positive diagnosis made as to whether it was rabies or not. The horse was noticed to be unwell sometime during the previous day, but did not attract any particular attention until night, when, as they describe it, he was very nervous and seemed to be frightened. He was sweating. In the evening they telephoned for me to come to see him. I saw him on the following morning. On going into the barn in the morning, I found the horse down. One young man went into the stall, and the animal grabbed him by the leg and would not let go for some time. It bruised and lacerated his leg quite a bit, and in trying to pull its jaws apart he cut his fingers on the horse's teeth. They finally got the horse up and turned him out. He then would bite at everything that came in his way, including fences and stones. The animal's incisor teeth were broken to some extent by this biting. During the night its appetite was good, since the manger was empty in the morning. It was about five o'clock in the morning when they turned the horse out of the stable. He was around the yard for a couple of hours, went out into the road once but came back, laid down and was dead in one half hour or so. He did not show any particular paralysis before he died.

On post-mortem, I could not see that the brain showed anything abnormal except a little congestion. There were a few small hæmorrhagic spots in the muscles all over the body, but particularly in the heart. The heart muscle was all darker than normal and had hæmorrhagic spots all through it. There were also petechial spots on the endocardium, and the heart muscle also seemed to be softened as if it had been cooked. You could push your finger into it any place with the greatest ease. The blood scarcely coagulated. It was very dark in color. A patch in the stomach was inflamed. The mucous membrane was thickened and red. Other than this I could see nothing abnormal. I had not seen the horse until after it was dead.

(Signed) H. C. PETERS.

Under date of Oct. 21, 1902, Dr. Peters supplied the following additional information:

I had not heard of any other cases of rabies in the vicinity of where the horse died until after the horse was dead. Since then, however, I have been told that a dog near this place died about four weeks before the horse did, showing some symptoms of rabies, such as biting at itself and other objects which came in its way. It lived three days after it got sick. When it died it was buried. I dug up this dog and found its stomach to contain a lot of hair, straw and dirt. This would be indicative of rabies.

H. C. PETERS.

When the specimen from the horse was received in the laboratory, some decomposition had already set in since it was not

packed in ice. From the cerebellum and medulla, a colon-like bacillus and a bacillus which produced a yellow growth on agar, were isolated. From an emulsion of the medulla, rabbits Nos. 613-614 were inoculated subdurally. These died after 18 and 12 days respectively, having shown symptoms of rabies. From rabbit No. 613, a second series, rabbits Nos. 620-621, were inoculated subdurally. These died after 14 and 18 days respectively, after exhibiting symptoms of rabies.

Nov. 5, 1902, Dr. N. Barsness, interne at Luther Hospital, St. Paul, Minn., telephoned that the young man who had been bitten by the horse noted above was then in Luther Hospital. Dr. Barsness stated that the wound was healing nicely and the patient making a good recovery. Dr. Barsness was told then and Dr. Boeckmann, who had the case in charge, on the following day, that the horse had certainly died of rabies. It was pointed out to Dr. Barsness on November 6th by telephone, that owing to the long time, one month, which had elapsed since the biting, there would be little use of the Pasteur treatment for the patient at that time, and that the likelihood of the patient developing rabies was minimized with the elapse of each day. Furthermore, that only 17 per cent of the people bitten by rabid animals developed rabies, and finally that with these facts in the possession of the Luther Hospital authorities the matter of deciding what to do depended entirely upon the personality of the person making the decision.

Outbreak 88—*Silver Lake, McLeod Co.* (*Child*).—The first information concerning an outbreak of rabies in Silver Lake, Minn., received by this Board, was contained in the following letter:

Silver Lake, Minn., Oct. 26, 1902.

The dreadful disease, hydrophobia, has manifested itself in this community. From its effects, a whole family (Mr. J. W., his wife and three children) are in Chicago receiving the Pasteur treatment. Another case, a girl 14 years old, whom I was called to see to-day, is in the maniacal (excitement) stage and will probably die within 36 to 72 hours. Several dogs that were running at large supposed to be suffering from rabies, were shot. I have heard of others that seem to act strangely. Of course, I advised their immediate destruction. I am afraid of gravest consequences yet to come, and therefore hasten to ask you what steps should be taken to eradicate the disease. Please state what local quarantine on dogs can be enforced. It occurs to me that all dogs should be either muzzled or tied and that those that run at large, after due notice to their respective owners, should be shot. Kindly advise me.

T. W. HOVORKA, M. D., H. O.

The Veterinary Department of the Board was also notified of the disease in the following letter:

Hutchinson, Minn., Oct. 28, 1902.

Dear Doctor: A few miles from here they evidently have rabies. One man had a horse die showing symptoms of that disease. They called me up by 'phone but I was away at the time. The horse was bitten by a dog which the same day bit a girl slightly. The dog was killed. The party came here after the horse died. The doctors here advised him to go to Chicago with the girl and take the Pasteur treatment. He had been at work on the horse with sore hands. I understand that six of the people went to Chicago. They have another horse which is being carefully guarded. Dr. Sheppard, of this place, was called to see a girl yesterday in the same locality. He tells me that it was a pure case of rabies. The girl died. Another party had some hogs bitten. Dr. Sheppard asked me to write you for information as to what to do in regard to the animals bitten. The man that had the hogs bitten has sold some of them and does not know which hogs were bitten.

H. C. LYON, V. S.

Drs. Hovorka and Lyon were immediately communicated with, suggestions were given concerning quarantine, etc., of the bitten animals. No further information was received from either of them.

The Common Council of the Village of Silver Lake, published an order that all dogs should be locked up, chained or muzzled, and that all dogs running at large, unmuzzled, for a period of 60 days after Oct. 28, 1902, should be shot.

Outbreak 89—Ossco, Hennepin Co. (Calves)—Lab. No. 82.—Saturday, Nov. 1st, 1902, Mr. A. Zimmerman, chairman, Board of Supervisors and Mr. D., of Osseo, Minn., brought to the laboratory the head of a calf. Dr. C. C. Lyford, of Minneapolis, telephoned in the morning that Mr. D. had consulted him concerning the calf which had died Oct. 23, 1902. Mrs. D. had been feeding this calf while it was sick, and Mr. D. was fearful lest the calf had died of rabies. That the saliva from the calf had covered Mrs. D.'s hand, on which there may have been a fresh cut or tear. Accordingly he dug up the calf after it had been buried and brought the head to Dr. Lyford, who sent him with it to the laboratory. The head was much decomposed when received.

From the medulla, two rabbits, Nos. 618-619, were inoculated. These died after 19 and 22 days respectively. From the medulla of rabbit No. 618, a second pair of rabbits were inoculated, Nos. 626-627. Rabbit No. 626 died 39 days after it was inoculated. Rabbit No. 627 remained alive and well during the ensuing four months, after which time it was used for another purpose.

Outbreak 90—Bear Lake, McLeod Co. (Dog).—The only information concerning these cases received by this Board was contained in the following letter:

Bear Lake, Minn.

Dear Sir: There is a case of hydrophobia in this town at P. F. M.'s. A strange dog bit some of his hogs. Two of the hogs died. He shot and killed the dog. This was in the month of November (1902).

(Signed) E. WILLIAMS, Town Clerk.

Outbreak 91—Clear Lake, Sherburn Co. (Child, Dog)—Lab. No. 83.—Nov. 17, 1902, there was received in the laboratory a portion of the spinal cord and medulla of a dog. The specimen had been sent by Dr. E. A. Woods, of Clear Lake, Minn., to the Secretary of this Board and forwarded by him to the laboratory. Accompanying the specimen was the following letter:

Clear Lake, Nov. 13, 1902.

I am sending a specimen of the upper end of the spinal cord and medulla of a dog that is supposed to have had rabies. The history is as follows: A strange dog bit a boy, 17 years old, in the cheek, making an ugly wound; also in the upper eyelid, tearing the tarsal cartilage into two pieces. The nose was scratched just deep enough for bleeding. I dressed the wound and cauterized it the best I could. I redressed it this morning and it is doing nicely. This dog bit two other dogs and then ran on towards the Mississippi river. It then turned south until nearly opposite Becker. It was followed by a number of armed men and shot at this point. I am told that he bit at everything in his path. The dog was brought to the town and I have opened the head at the base of the skull and send you the specimen removed. I ordered the two dogs that were bitten chained up. Please telegraph the report of this specimen, and if positive, I will send the boy to the Pasteur Institute.

(Signed) E. A. WOODS, M. D.

Two days before the specimen was received the above letter from Dr. Woods arrived.

Dr. Woods was written to immediately, *i. e.* Nov. 15, 1902, by the Director of the laboratory, as follows:

Dear Doctor: Your letter of Nov 13th has just been forwarded to me by Dr. Bracken, to whom it was addressed. The specimen of the dog's head mentioned therein has not yet been received. From what you say I infer that the specimen is from the dog which bit the boy—age 17 years—in the upper eyelid and cheek. If the history as you give it be substantiated by closer inquiry by yourself, it would seem to point to a diagnosis of rabies. It would be impossible for us to give an opinion on the specimen forwarded, for at least two weeks, and perhaps longer. Under these circumstances, it will be dangerous for you to wait until a laboratory opinion is given, because if it is

advisable for the patient to receive the Pasteur treatment, he should receive it at once. The Chicago address, is, I believe, Dr. Lagorio, Pasteur Institute, 228 Dearborn St., Chicago, Ill. There are other Pasteur Institutes in Baltimore and New York whose addresses I could give you, though you asked only for the Chicago one.

Upon receipt of the specimen in the laboratory, Nov. 17, 1902, Dr. Woods was again written to by the Director of the laboratory, as follows:

Minneapolis, Minn., Nov. 17, 1902.

Dear Doctor: The specimen of dog's brain mentioned in yours of Nov. 13th and forwarded by you on Nov. 12th to Dr. Bracken, was received this morning in the laboratory by mail. The specimen was putrid on its arrival and consisted of a small amount of brain substance in the bottom of a wide mouthed bottle, of which the cork was paraffined. On removing the string from the neck of the bottle, the cork was forced out by the accumulation of gas due to putrefaction. I scarcely think we shall be able to give an opinion on this case at all, as it is extremely likely that the rabbits inoculated will die from septic meningitis before symptoms of rabies have time to develop. We are, however, making the inoculations, having entered the case on our record as rabies case No. 83, and shall let you know as soon as we are in a position to report at all.

From the material noted above, rabbits Nos. 624-625 were inoculated subdurally. These died after 11 and 5 days respectively, having shown symptoms of meningitis. At autopsy, both animals showed intense meningitis. One rabbit, No. 625, showed an area of yellowish pus, subdurally, at the site of inoculation. Cultures from both rabbits showed *B. coli communis* in abundance.

Dr. Woods was informed of the results of the inoculations on November 28th, the date of death of rabbit No. 624.

In reply, under date of Nov. 30, 1902, Dr. Woods wrote as follows:

Little is known of the first dog concerned in this case of rabies more than the biting of a boy, and three other dogs. The case is now a clear one of rabies, because one of the dogs was preserved, chained up and fenced in. He developed a disease undoubtedly rabies. When this dog came down with rabies, the boy had received eight days' treatment by Dr. Lagorio in the Pasteur Institute in Chicago and the next morning. I received a telegram from Dr. Lagorio stating that the boy had developed hydrophobia. I at once sent the father to Chicago and have received word from him by telegraph that the boy has died. The boy was only sick two and one-half days. Since then I have received a letter from Dr. Lagorio stating that the bites were in a very dangerous location and very severe.

To go back to the morning that the case began. The boy was bitten at six o'clock in the morning. He immediately took after the dog with his gun,

running and stimulating his circulation. He came into my office near noon. I cauterized the would immediately with permanganate of potassium and put in seven stitches. I then began my work of investigating the dog, which I opened and sent a part of to the laboratory through Dr. Bracken. I waited for your report before sending the boy to Chicago and when your first letter of Nov. 15th came, I found you had received the letter, but not the specimen. The next day another letter from you stated the condition of the specimen and that it would probably take two weeks to get the results required unless septic meningitis developed in the meantime, as it has. When I learned the length of time required, I sent the boy at once to Chicago. It may be that had I sent the boy to Chicago the afternoon of the day he was bitten, that Dr. Lagorio could have saved him, but with a case like that where there is quite a little expense to the father, he and the rest of the family wanted to know if the dog was mad, and of course, we could not tell him positively at once. Another time, I shall insist on Pasteur treatment immediately. The dogs of this village have been ordered muzzled or tied up, and any strange dogs traveling through here are liable to be shot. This holds good until Feb. 1, 1902.

(Signed) E. A. WOODS, M. D.

In a note on a formal report blank, Dr. Woods gives the following additional information: "Besides the boy, the dog was known to have bitten three dogs. These three dogs were tied up and fenced in to be watched. The owners of two of them shot their dogs before symptoms appeared of any sickness. The third dog developed sickness after 15 days' incubation and showed all the typical symptoms of rabies in the dog."

In relation to this outbreak, the following letter from the chairman of the town board of Becker, near which place the dog that bit the boy was killed, is herewith presented:

Becker, Minn., Dec. 4, 1902.

The mad dog which bit the young man in Clear Lake, Minn., came to Becker, and bit two other dogs, both of which went mad. The owners of the dogs did not tie or muzzle their dogs and one of them bit a boy but did not bring blood. He also, bit the tails of two cattle. The cattle were bitten about five o'clock in the afternoon. Next morning, the owner of the cattle cut off their tails. Would that save them? After biting the cattle, the dog was seen about two miles from home on the same afternoon where he bit three more dogs that we know of. These were killed. Several other dogs that we know of were also bitten.

On Nov. 29, 1902, two cattle went mad. These were probably bitten by the dog which bit the boy. The board of supervisors put up a notice that until further notice any dog found running at large and not properly muzzled would be killed.

(Signed) IRVINE S. WAGNER, Chairman, Town Board.

Dec. 8, 1902, Mr. E. F. Carlin, chairman of the Board of Supervisors of the town of Palmer, Sherburn Co., reported to this Board as follows:

"There is a mad dog scare in this town on account of several cases in the adjoining town of Clear Lake. One case, a steer, has gone mad in this town. Has the town board power to compel all dogs to be muzzled or tied up?"

Outbreak 92—*Middleville Twp., Wright Co.* (*Cattle*)—*Lab. No.* 84 and 84a.—Nov. 24, 1902, Dr. Brimhall went to the farm of Mr. B., Middleville Twp., Wright Co., to investigate an outbreak of obscure disease in cattle. Six cattle had died in the vicinity in the two weeks immediately preceding Dr. Brimhall's visit, all apparently of the same disease. Of these, Mr. B. had lost three, one neighbor two, and another, one. A rabid dog had been through the neighborhood about a month before and was known to have bitten some of the animals, but not all of them.

One cow, the property of Mr. B. had died just before Dr. Brimhall's arrival, and another was in the last stages of the disease. From the description given by those who had attended the animals, and from the symptoms of the dying animal, a provisional diagnosis of rabies was made.

Dr. Brimhall collected milk from the cow which was sick, and made an autopsy on the animal which had recently died. There were apparently no gross lesions except congestion of the meninges.

A portion of the spinal cord of this cow was brought to the laboratory. From this spinal cord, rabbits Nos. 628-629 were inoculated. Rabbit No. 628 died after twenty-seven days. Rabbit No. 629 died in eighty days. No bacteria were recovered in cultures from the original material or either of the rabbits.

Though but one pair of rabbits was inoculated from this case, and though death in one of these was delayed for a period of eighty days, yet the laboratory examination would seem to bear out the clinical diagnosis of rabies.

The milk from the second cow (see above) was inoculated subdurally into rabbits Nos. 630-631. These showed no symptoms during the ensuing three and one-half months, after which time they were used for another purpose.

Outbreak 93—*Willmar, Kandiyohi Co.* (*Dog, Cattle, Horse*).—The first information concerning this outbreak was received by the secretary of the board in the following letter:

Willmar, Minn., Oct. 22, 1902.

Dr. Bracken: Last Friday I was called to Mr. E.'s., section 25, West Lake Lillian. The farmer (Mr. E.) told me that his dog, about five weeks ago, acted strangely, tearing around the barn yard and biting at cows' and horses' heels and chasing them. He went to two of the neighbors and bit their dogs. He disappeared after that and they have not seen him for four weeks. The neighbors killed their dogs that he had bitten. One of Mr. E's. cows took sick about Oct. 12, i. e. four weeks after being bitten. The cow acted like the dog, chasing the young stock around, hooking them and bellowing. She had not eaten anything in three days. When I saw her she was tied up in a stall. She moaned constantly. She had not been up for two days. About the third day, the cow commenced to lose all power in its hind extremities. She died the next day after I saw her. I told him to burn her and burn all straw in the manger and close it up.

Mr. E. telephoned me to-day that another cow had taken down like the first one and wanted to know what to do. He said if she was not better to-morrow, Thursday, he was going to kill her. I was suspicious of rabies, but it may be meningitis. Mr. E. will call me up in the morning. What shall I tell him to do? Should we remove the head and send it down for examination or had you better send someone out there. I had him tie up the cow in a stall by itself.

(Signed) J. M. RAINS, M. D.

Dr. Bracken replied to Dr. Rains saying that both veterinarians were in the field on other work at the time, and that consequently it would be impossible to send any one from the department to make the examination. Dr. Rains was asked to send in a specimen and advised as to quarantine measures, etc.

Nothing further was heard from Dr. Rains until under date of Dec. 4, 1902, the following note was received:

I enclose a clipping from the Willmar Republican Gazette, of Dec. 4th. You will remember that I wrote to you Oct. 22nd about a farmer by the name of E. who at that time had lost three head of cattle. I had heard nothing about the cases until I read this item in the paper yesterday.

(Signed) J. M. RAINS.

The clipping referred to was as follows:

Veterinary Surgeon Ilstrup, of this city, was last week called to Lake Lillian town to treat a horse which had been acting strangely for some time, and found the animal had been suffering from rabies and that two dogs and three cattle had also died of the same disease. The horse became so vicious that it would allow no one to care for it, and when the hired man at the farm of the owner, Mr. W. L. went in the stall to feed it a day or two ago he was bitten on the arm. The animal drew blood on his arm but the man does not believe the teeth touched his flesh as he wore a heavy sweater. It reduced the stall to fragments and finally a veterinary surgeon was called.

When Dr. Ilstrup arrived, he found the animal dead, but the symptoms from which it died left no doubt that it had been afflicted with rabies. The animal had been turned loose in the yard and it had bitten several other dogs and cattle.

Mr. E., another farmer in the same town, who lost three head of cattle from rabies some time ago, is a neighbor of Mr. W. L., who owned the horse. Mr. E.'s. dog bit his cattle which died, and the disease in the horse is believed also to have its origin with this dog.

Mr. Frederick Linn, C. B. S., of Lake Lillian, was sent a copy of the above clipping and asked to furnish any additional information. In addition to the facts noted above, he said: "After they got the horse tied up, he began biting at his own legs and the manger. The horse was bitten by Mr. M. E.'s dog of Lake Lillian. I understand that there have been twelve or fifteen dogs killed in that neighborhood (Lake Lillian) that have shown sickness since the first case."

Mr. Olaf Wallin, Svea, Minn., chairman of the town of Rosebud, also made a formal report of a case of rabies in a horse, the property of W. L. In addition to the facts noted above, Mr. Wallin says: "The horse bit at some other horses, but Mr. L. does not know if it was enough to hurt any of them." Concerning the animal which bit the horse, Mr. Wallin says: "It was a dog which came over to Mr. L.'s place in October. The dog was unknown. No one knows where he came from or what became of him. This dog also bit a small dog belonging to Mr. L., and the small dog bit one of Mr. L.'s little boys. The small dog was killed when he bit the boy."

As a sequel to the above cases, Dr. Rains reported, under date of Feb. 16, 1903, another case as follows:

"Mr. B. E. B., section 33, Lake Elizabeth, was in to see me today about a mad dog that came to his place yesterday and bit a sheep, a lamb and also some calves before they could shoot him. The dog belonged to his neighbor, Mr. I. W. According to his story, the disease is in both East and West Lake Lillian townships and also in Lake Elizabeth."

Mr. O. C. Peterson, C. B. S., of Lake Elizabeth, was asked to give further information concerning this dog, and under date of March 10, 1903, reported as follows:

I have been investigating our town and find that all the dogs that were affected with rabies were killed so far as I know.

(Signed) C. O. PETERSON,
Atwater, Minn.

In addition to the above, the following report was received March 16, 1903:

Willmar, Minn., March 14, 1903.

I hereby report to you that on the 6th of March, I had a dog killed with symptoms of hydrophobia. The owner's name and address, Miss F. L., Willmar, Minn. On March 8th, I saw a horse with symptoms of hydrophobia, and the owner reported on the 9th, that he had killed it as it had become unmanageable. The owner's name and address was N. T., town of Fahlun, Willmar, Minn.

(Signed) NELS TRUELSON,
Fahlun Twp., Kandiyohi Co., Minn.

Outbreak 94—*Herman, Grant Co.* (*Dog*)—*Lab. No.* 85.—Jan. 5, 1903, there was received in the laboratory a specimen of spinal cord of a dog from Herman, Minn. Concerning the specimen the following postal card was received:

Herman, Minn., Jan. 2, 1903.

I send you to-day, a specimen of spinal cord of a dog suspected of rabies, which you will greatly oblige me by examining and making a report at your earliest convenience.

(Signed) G. E. McCANN, M. D.

In reply to a request for further information, Dr. McCann furnished the following facts on a formal report blank:

"The dog was the property of Mr. A. A. of Herman, Minn. On Dec. 28, 1902, it was taken with a convulsive attack and started through the streets, biting and snapping at everything in reach. It bit several dogs and one child. It was shot within about two hours after it showed symptoms."

Immediately upon the receipt of the circular containing the above data, the director of the laboratory wrote Dr. McCann as follows:

"As I said in my letter of January 6th, it will be unsafe to await the results of the laboratory findings before Pasteur treatment is given, if that seems indicated. Such a matter should be attended to on the basis of clinical findings. If you have reason to believe that this dog was rabid, it would have been the safe thing to do to have the child treated. That was why I mentioned the matter immediately upon writing to you on January 6th."

It will be seen from the above that eight days had elapsed between the time when the dog was shot, Dec. 28, 1902, and the time when it was received in the laboratory, Jan. 5, 1903.

When received the specimen was in a small glass-stoppered bottle without ice packing. Cultures from the material showed a white staphylococcus and a large putrefactive bacillus. Rabbits Nos. 652-653 were inoculated subdurally with an emulsion of the cord and died in 22 and 19 days respectively, after exhibiting symptoms of rabies. From the medulla of rabbit No. 653 a second series of rabbits were inoculated, Nos. 662-663. These died after 20 and 33 days respectively, having shown symptoms of rabies.

Immediately upon the death of the last animal, Jan. 28, 1903, Dr. McCann was informed of the positive diagnosis of rabies in the case. In reply Dr. McCann wrote as follows, under date of Jan. 31, 1903:

"Some one-half dozen dogs that were bitten by the dog from which you received the specimen Jan. 2, 1903, have been afflicted with the same disease, namely, rabies. The children who were bitten have shown no signs of the disease and were taken to Chicago for treatment yesterday. I agree with you in saying that they would not be likely to suffer any ill effects after so long a time, especially as the wound received prompt attention. I was unaware that more than one child had been bitten until yesterday. Of course, the danger of their being affected is small, but we thought it best not to take any chances. The most stringent measures have been taken to stamp out the disease, and I think it is pretty well under control."

Outbreak 95—Clara City, Chippewa Co. (Dog)—Lab. No. 86.—Jan. 14, 1903, there was received in the laboratory the head of a dog from Dr. A. A. Rankin, of Clara City, Minn. Accompanying the specimen was the following letter from Dr. Rankin:

Clara City, Jan. 12, 1903.

Dear Doctor: I am sending you by express the head of a large dog, suspected of rabies. The dog was killed before I could prevent it, by a mob of men and boys, who may have shot up the head badly. Saturday, Jan. 10th, this dog came to town. He was trotting around town all that day, snapping at every dog that came within reach and biting at sticks, etc., thrown at him. He did not snap at any people so far as has been reported. He would not run even when chased or shot at, but traveled at a slow trot or walk all the time. He seemed to go around the town and come back to the same spots again and again. The owner is unknown, though he is thought to be a farmer, six miles out of town, Mr. M. B., in the town of Lone Tree. It is stated that Mr. B's. dog was bitten by another suspected dog last summer. The particulars, however, are very vague.

All the dogs in town have been shut up, muzzled or shot on order of the city council.

The head of the above mentioned dog when received in the laboratory was in good condition.

From the medulla, rabbits Nos. 659-660 were inoculated subdurally. They both died in nineteen days after exhibiting symptoms of rabies. A positive dagnosis of rabies was made on the findings in these two rabbits.

Outbreak 96—Grey Eagle,Todd Co. (Cow, Swine)—Lab. Nos. 87-88. Feb. 20, 1903, there was received in the laboratory the heads of one cow and three hogs. Acompanying the specimens was the following letter:

I am sending to-day some heads of animals for examination. They are supposed to have rabies. All were bitten by a dog that gave all the symptoms of rabies. He went through the northern part of this township and bit eleven hogs, one cow and two or three other dogs, All animals died the typical death with the exception of three hogs, which I ordered killed yesterday. These three were sick. I have posted notices in the neighborhood to muzzle or confine all dogs, but as it is four or five miles from this village, I do not think such an order is necessary in the village. Do you? I might say that the dog that did the dirty work, is dead.

(Signed) R. P. STOREY, M. D.

From the medulla of the cow noted in the above letter, rabbits Nos. 677-678 were inoculated subdurally. These died after 21 and 18 days, respectively, having exhibited symptoms of rabies. From the medulla of rabbit No. 678, a second pair of rabbits, No. 712-713, were inoculated. Rabbit No. 712 exhibited no symptoms to date, an interval of three months. Rabbit No. 713 died after 42 days.

From the medulla of one of the hogs noted in the original letter, rabbits Nos. 679-680 were inoculated. Rabbit No. 679 died three days after inoculation. Rabbit No. 680 lived four months.

Though the results of the laboratory examination in the above cases was somewhat unsatisfactory, yet a diagnosis of rabies in case 87 (cow) would seem to be warranted.

Outbreak (?) 97—*Belle Plaine, Scott Co. (Cat)—Lab. No.* 89.—Feb. 25, 1903, there was received in the laboratory the body of a large ring-streaked cat from Dr. G. R. Moloney, of Belle Plaine, Minn. Concerning the specimen the following letter was received from Dr. Moloney:

Belle Plaine, Minn., Feb. 24, 1903.

I send you by this afternoon express a dead cat that on last Sunday, Feb. 22nd, bit two children, of the ages of 12 and 7, cutting them slightly, and drawing a little blood. This cat did not belong to the house where the chil-

dren lived. It came to the house three months ago. The people did not know from what place. As the children were passing it in the yard, the cat jumped from under a sleigh and bit one of them on the hand. The other child took up a stick and the cat then bit him. The parents of the children are fearful lest the cat may have been in a mad condition. It was not noticed to be sick at any time and there have been no cases of rabies in the neighborhood, so far as we know. The cat is supposed to have been the property of Mr. J. N., of Belle Plaine. It was in the habit of going into the woods in the summer time.

(Signed) G. R. MOLONEY.

On removing the medulla and base of the brain of the cat mentioned in the above letter from Dr. Moloney, much blood was found about the meninges, though it was impossible to determine whether this was ante-mortem since the cat had been shot or struck over the head.

The material from the medulla was used for inoculating broth and serum cultures. After 24 hours in the incubator there developed an apparently pure culture of a large diplococcus in the broth. On the serum on which a heavy sowing had been made, 12 colonies of diplococci giving a similar appearance developed. Subsequent cultures from all of these on various media gave all of the cultural characteristics of *diplococcus pneumoniæ*.

Material from the medulla was used for inoculating rabbits Nos. 681-682 subdurally. These rabbits have shown no symptoms to date (after three months).

It would therefore appear (1) that the case was not rabies, and (2) that it may have been meningitis due to *diplococcus pneumoniæ*, though the history of clinical symptoms, the crushed condition of the brain of the animal, together with the possibility of contamination of the material, would make such a diagnosis from the bacteriological examination alone somewhat doubtful.

Outbreak 98—Freeport, Millwood Twp., Stearns Co. (Swine).—The only information concerning the above cases received by this board was in the form of the following notification:

Feb. 24, 1903.

Our chairman had such a troublesome disease in his case that immediate killing was necessary. We are near Todd Co., Grey Eagle Twp., where some hogs and some other animals were infected, and physicians declared necessary the killing of the hogs, so we entered his premises and killed his two hogs which were infected with rabies. See the accompanying statement.

(Signed) ANTON WILMERDING.

Accompanying the above letter was also a formal statement from Mr. Wilmerding, stating that the board of health of Millwood

Township had entered the premises of the owner of two hogs suffering from rabies and killed them for the safety of the general health. The value of the hogs was appraised at $10 each. The owner hoped to recover their value from the state.

Outbreak 99—*Clinton, Bigstone Co.* (*Dog*).—The only information at hand concerning this case is contained in the following letter:

Clinton, Minn., Feb. 27, 1903.

Given a case of a pet dog, a cross between a pug and Scotch terrier, bitten about 18 days prior to the first symptoms, by an Irish setter, inclined to bite all dogs and later dying on account of some trouble, most manifest in the throat, as expressed by the owner of the setter.

The first symptoms manifested by the pet dog were disinclination to take food or drink, a slow irregular pulse, constipation, dropping of lower lip, gradually increasing to opening of mouth, protruding tongue, labored breathing increasing day by day. The third or fourth day of illness, some cough, each time usually followed by vomit looking as though it had been mixed with some black coloring matter. Up to the fifth day there was absolute aversion to water. When left alone on the fourth day, the animal would sit up in his nest and snap at supposed imaginary objects, as though he were snapping at flies. On the morning of the fifth day, he commenced to drink water copiously. There was no more snapping at imaginary objects. The gait was staggering, the breathing very labored and there was occasionally black vomit. The animal would bite at his head occasionally. It was evident that the dog could not recover and he was killed. Could you give a diagnosis of the disease?

Other dogs that were bitten acted strangely at about the same time. One or two died and others were killed. Most of them developed a tendency to snap at other dogs. Have not heard of any of them trying to bite other stock or people except in two instances. Here the attempts were unsuccessful.

Thinking perhaps there may be an element of rabies in the epidemic, the village board of health has ordered all dogs confined or muzzled for 20 days. We shall be glad to hear of your opinion in the case of the pet dog.

(Signed) S. C. BOROM, M. D.

From the description in the above letter, Dr. Brimhall felt warranted in giving a diagnosis of rabies.

Outbreak 100—*Alden, Freeborn Co.* (*Dogs*)—*Lab. Nos.* 90-92.—March 4, 1903, there was received in the laboratory from Dr. Robert Williams, Alden, Minn., a two-ounce bottle containing about a drachm of bloody fluid. Accompanying the specimen was the following letter:

"Enclosed is a specimen of saliva taken from a dog showing symptoms of hydrophobia. There was no frothing at the mouth nor any definite symptoms except that he acted strangely, snap-

ping at other dogs and seemed somewhat blind. He was shot before any chance was allowed for observing him. No person was bitten, but perhaps some other dogs were. Let us have a telegraphic report if any positive diagnosis is made, so that we may take ample precautions."

In addition to the above information, Dr. Williams later wrote "that the owner of the dog was unknown, and that four other dogs were known to have been bitten by this one, which was killed two hours after it first appeared in the town."

From the fluid (saliva) mentioned above, direct coverslip preparations stained with eosin and methylene blue showed large and small bacilli and staphylococci. Cultures in broth and on serum showed a white staphylococcus, colon bacillus and a very small, non-motile bacillus which grew with a fine growth on all solid media, did not coagulate milk or form acid or gas. In addition there was also a larger, non-motile, evenly-staining bacillus which formed a slight pellicle in broth, did not form acid or gas and grew with a moist, yellow growth on serum and agar.

From the original fluid (saliva) rabbits Nos. 699-700 were inoculated subdurally with 0.2 c. c. each. Rabbit No. 699 died in less than 24 hours. An autopsy on this rabbit showed intense meningitis, while cultures and direct coverslip preparations showed the presence of *B. coli communis*. Rabbit No. 700 died after 72 hours. An autopsy showed meningitis as in rabbit No. 699, while cultures from the meninges showed also the presence of *B. coli communis*. Since the symptoms in this rabbit resembled somewhat those of rabies, two other rabbits, Nos. 706-707, were inoculated subdurally with a portion of the medulla of rabbit No. 700. One of these, rabbit No. 706, is still alive after three months, having shown no symptoms in the meantime. The other rabbit, No. 707, died on the seventh day after inoculation. The meninges at autopsy were found to be congested.

Guinea pig No. 564 was inoculated subcutaneously in the right groin with 1 c. c. of the original material (saliva) from the dog. The animal remained alive and well for two months and then died of pneumonia.

Under date of March 6, 1903, Dr. Williams wrote as follows:

"I regret that I cannot send the brain of the dog, as it was buried in a low place and is covered with mud and water. I am in hopes that you can do something with the material (saliva) already sent. I have considerable doubt about the dog being mad, but wish to protect the community."

March 13, 1903, there was received in the laboratory from Dr. Williams the head of a large black and yellow mongrel dog. Accompanying the specimen was the following letter from Dr. Williams:

The supposed mad dog, head contained within, was shot March 10th, after acting queerly. It had bitten several cattle and horses and a few dogs. All of these dogs have been killed. This dog was bitten by the dog whose saliva I sent you March 3rd. No very definite symptoms were manifest, but we are anxious to find out definitely in regard to the matter, as there is considerable alarm over it.

(Signed) ROBT. WILLIAMS, M. D., H. O.

The specimen noted above was wrapped in oil cloth, packed in sawdust and soldered up tightly in a tin box which was enclosed in a wooden box.

On opening it in the laboratory the head seemed in good condition. The spinal column was sawed off near the base of the skull, the end of the cord flamed and a portion of the medulla removed with a sterile curette. An emulsion was made from this, and rabbits Nos. 715-716 were inoculated subdurally. Direct coverslip preparations from the original material showed no bacteria. The inoculation material showed a large bacillus which formed a heavy pellicle in broth, and gave a heavy, gray growth of all solid media.

Of the first pair of rabbits inoculated, rabbit No. 716 died after 19 days, having shown symptoms of rabies. From the medulla of this rabbit another pair, rabbits Nos. 739-740, were inoculated subdurally. These died after 20 and 15 days respectively, having shown symptoms of rabies.

It will thus be seen that a diagnosis of rabies was warranted in the laboratory findings in the second case, which would also make positive the diagnosis of rabies in the case of the first dog.

Outbreak 101—*Faribault, Rice Co.* (*Swine, Dog*)—*Lab. No.* 91.—March 9, 1903, there was received in the laboratory from Mr. R. J. L., of Faribault, Minn., the head of a large Poland-China pig. Accompanying the specimen was the following letter from Mr L.:

Dear Sir: Some six weeks ago, a strange dog came around my farm and engaged in a fight with my dog. It was frightened away. Immediately afterward, it was killed, while engaged in running the hogs. Since then I have lost six animals at different times, and think they have come in contact with some contagious disease. Have been advised to ship you the head of one of the hogs. Kindly advise me as soon as you can, as to the cause of their death.

(Signed) R. J. L.

Dr. D. M. Cool, H. O., of Faribault, Minn., was asked to supply further information concerning this case, and under date of March 24th wrote as follows:

"Replying to yours of recent date asking for information as to the number of hogs Mr. L. lost, Mr. L. has lost seven in all. I have made some inquiries regarding loss by other neighbors. It seems this dog was a tramp. At least he belonged to no one in the vicinity of Mr. L.'s farm. He was shot before he had time to get away. So far I cannot find that any one has lost any animals from this or any other dog. Some have shot their dogs on the supposition that this one bit them, thus not giving them time to develop the disease. There is a possibility that this dog or the hogs might have rabies. If I can get any further light on the matter, will address you concerning it."

In addition to the above letter, Dr. Cool furnished on a formal report blank the following data:

The hogs were at first stupid and sleepy and inclined to lie still. One, however, was very ugly and would bite a stick and get much excited. They all made an effort to get up, but would fall down with spasmodic action of the limbs. All of them, most of the time, were apparently exhausted and weak. There was loss of appetite from the first. The first animal got sick about the first of February. I cannot give exact dates of the deaths.

(Signed) D. M. COOL.

The head of the pig noted above when received in the laboratory was packed in a box in a large amount of sawdust and straw. There was no wrapping about it. The spinal column was sawed off near the base of the skull, the end of the spinal cord flamed and a portion of the medulla was removed with a sterile curette. Cultures from the material showed a white staphylococcus and *B. coli communis*. An emulsion was made of a portion of the medulla, and rabbits Nos. 709-710 were inoculated subdurally. These animals died after 21 and 17 days respectively, having exhibited symptoms of rabies. A diagnosis of rabies was therefore made.

Outbreak 102—*Cedar, Anoka Co.* (*Dog*).—April 9, 1903. The only information at hand concerning this case is contained in the following letter:

There was a dog around here on Thursday of last week (April 2nd). He bit several dogs in this neighborhood. On Saturday morning (April 4th), I saw him coming along the road. I got my rifle and shot him, but our dog

started to fight him before I could kill him and I think he must have bitten our dog, as his left hind foot is swollen. Do you think it would be best to kill him or not? I have him chained up so that nothing can come near him. How long will he live if he goes mad? I do not want to kill him, as he is a valuable dog, but if he goes mad I will kill him.

(Signed) A. E. C.

Mr. C. was written to concerning the case, but nothing further has been heard from him. A diagnosis of rabies must remain in doubt in this instance.

History of the Disease in Minnesota—Very little is known concerning the date of the first appearance of rabies in Minnesota. The first cases actually observed of which any definite information can be obtained are those of Dr. Richard Price, V. S., St. Paul., who has given more clinical study to this disease in animals than any one else in Minnesota.

Dr. Price has very kindly afforded the following information:

"In 1885 or 1886, a valuable pointer belonging to Dr. V., of St. Paul, developed a well marked case of furious rabies. * * * *

"In 1888, an outbreak of hydrophobia appeared in a herd of cattle on a farm belonging to Mr. J. C., about 15 miles west of St. Paul. Twelve deaths from rabies resulted amongst these animals, which had been worried by a strange dog some three of four weeks previous to the development of the disease in the cattle.

"In 1895, a dog belonging to Dr. S—k, of St. Paul, developed furious rabies and bit a dog belonging to Dr. S—e, which in due time developed the disease. After the first dog bit the second dog, he ran a distance of 18 miles in three hours, and at the end of his journey bit three calves before he was killed.

"In the same year, at Newport, Minn., 37 animals developed rabies and died."

As bearing upon the history of rabies in Minnesota, the following extract from remarks made by Dr. Sweeney, in opening the discussion on rabies before the Minnesota Sanitary Conference, January 14th and 15th, 1902, may be quoted:

"I understood from Dr. Hewitt that in 1890 a brief outbreak in animals alone occurred, but in 1894, the first case was recognized in a human being, and from that time up to 1900 there have been occasional outcroppings. In the first case a dog bit three people, two of whom died from rabies, and the other was sent to the Pasteur institute and is still alive. In the third case, two years later, three children were bitten by the same dog. Two died, one was

sent to the Pasteur institute and is still alive. The others were isolated cases. The diagnosis in four of these cases was settled by laboratory methods, by transmission of the disease to rabbits in varying series. In human beings in St. Paul there have been seven deaths. There have been a large number of cases of rabies in animals. Dr. Price, to whom we are all indebted for work relating to this disease, has estimated that probably 250 dogs have been proven to have rabies, both clinically and experimentally, during the past five years in St. Paul."

Table I. is a synopsis of the information concerning the outbreaks of rabies above reported in detail. In addition, certain data concerning Minnesota patients, afforded by the director of the Chicago Pasteur Institute since the preparation of the foregoing, are included. The Chicago report originally gave a list of 72 patients from Minnesota who were treated in Chicago during this time, and the names, addresses, dates, results of treatment and certain other collateral data were given. From this original list, 28 cases which received treatment in Chicago have been eliminated, since they are included in the 30 cases recorded in Table I. The remaining 44 cases treated in Chicago are listed immediately following Table I. Certain apparent discrepancies will be met with in comparing Table I. and its appended list of Chicago cases with the details noted under the individual outbreaks as having been afforded by the local authorities. These are due to the fact that the Chicago report contained records of a number of cases of which the Minnesota State Board of Health had no knowledge prior to the receipt of the report, *i. e.,* after the preceding portion of these investigations had been already printed.

TABLE I.—SHOWING OUTBREAKS OF RABIES IN MINNESOTA, 1896–1903.

No. of Outbreak	Date	Reporter.	Town.	County.	Men. Bitten	Men. Took Pasteur Treatment	Horses. Bitten	Horses. Developed Rabies	Cattle. Bitten	Cattle. Developed Rabies	Swine. Bitten	Swine. Developed Rabies	Sheep. Bitten	Sheep. Developed Rabies	Goats. Bitten	Goats. Developed Rabies	Dogs. Bitten	Dogs. Developed Rabies	Cats. Bitten	Cats. Developed Rabies	Laboratory Examination. Source of Material	Laboratory Examination. Case Number	Laboratory Examination. Diagnosis
1-39	Reported in Biennial Reports for 1895-1900. See table, Page 478 Biennial Report for 1899-1900.				10	7* 3†		2		19		8		7			Wolf	46 1					
	1900																						
39a	Mar 12	Mr L H Hoyt, T C	Fridley	Anoka					?	65								1					
40	Reported in Biennial Report for 1899-1900. Page 465.		Good Thunder	Blue Earth						1											Cow	47	+
41			St. Paul	Ramsey														1			Dog	48	+
42			Bemidji	Beltrami								1									Hog	49	+
43			Tracy	Lyon														1			Dog	50	+
44			Minneapolis	Hennepin														1			Dog	51	+
	1901																						
45	Jan 18	Dr. R. Price	St. Paul	Ramsey													3	3			Dog	52	+
46	Feb 28	Dr. L. Hay	Faribault	Riee							?	2					1	1			Hog	53	+
47?	Feb 28	Dr. M. H. Reynolds	St. Anthony Park	Ramsey																	Dog	54	—
48	Apr 15	Dr. L. A. Williams	Iona	Murray	1	1*			?		?						3	3			Dog	55	+
49	May 7	Dr. R. A. Campbell	Minneapolis	Hennepin	1	1†											1	1			Child	56	+
50?	May 17	H. G. Lytle, H. O.	South St. Paul	Dakota																	Dog	57	?
51?	May 20	Dr. J. G. Annand	Minneapolis	Hennepin													2	2					
52	June 8	Mr. A. H. F.	St. Paul Park	Dakota													?	2			Dog	58	+
53	Aug 13	Mr. Pomplun	New Canada	Ramsey													2	2					
53a	Aug 14	Dr. C. C. Lyford	Minneapolis	Hennepin			1	1													Horse	59	+
54	Aug 30	Dr. R. Price	St. Paul	Ramsey	1	1*											2	2			Dog	60	+
55?	Sept 27	Dr. C. C. Lyford	State Ex. Station	Ramsey																	Cow	61	—
56	Oct 21	Dr. F. M. Archibald	Harrison,	Kandiyohi	1	1§											1	1			Dog	62	+
57	Oct 29	Drs. Brimhall and Wilson	Taunton	Lyon					?	9							2	2			Cows	63,66	+
58	Nov 21	Dr. A. A. Keys	Bloomington	Hennepin	3	3*	?	1	?	2	?	1					?	3			Dog	64	+
59	Nov 26	Dr. R. Price	St. Paul	Ramsey	1	1*											?	2			Dog	65	+
60	Dec 8	Drs. Brimball and Wilson	Anoka	Anoka					?	4	?	4					1	1			Cow	67	+
61	Dec 9	Dr. J. G. Annand	Minneapolis	Hennepin													1	1					
62	Dec 8	Mr. L. H. Hoyt	Fridley	Anoka					1	1							?	2			Dogs	68-69	+?
63	Dec 17	Mr. L. L. Leland, C. B. S.	Porter	Yellow Medicine					1	?							1	1					
64	Dec 26	Mr. J. L.	Merriam Park	Ramsey							?	1					?	1			Hog	70	+
	1902																						
65	Feb 3	Dr. C. C. Lyford	Minneapolis	Hennepin					?	2							?	2			Cow	71	+
66	Feb 19	Dr. F. J. Bohland-Fuchs	Belle Plaine	Seott													4	4			Dog	72	+
67	Feb 26	Mr. L. H. Hoyt	Fridley	Anoka													4?	2					
68?	Mar 13	Dr. A. G. Moffatt, H. O.	Howard Lake	Wright																	Milk	73	—

TABLE I.—*Continued.*

No. of Outbreak.	Date.	Reporter.	Town.	County.	Men. Bitten.	Men. Took Pasteur Treatment.	Horses. Bitten.	Horses. Developed Rabies.	Cattle. Bitten.	Cattle. Developed Rabies.	Swine. Bitten.	Swine. Developed Rabies.	Sheep. Bitten.	Sheep. Developed Rabies.	Goats. Bitten.	Goats. Developed Rabies.	Dogs. Bitten.	Dogs. Developed Rabies.	Cats. Bitten.	Cats. Developed Rabies.	Laboratory Examination. Source of Material.	Laboratory Examination. Case Number.	Laboratory Examination. Diagnosis.
69	Mar 14	Mr. E. J. Rice, T.C.	Oronoco	Olmstead					?	3	?	1					2	2			Dog	74	+
70	Mar 31	Dr. H. E. Conley, H. O.	Cannon Falls	Goodhue	1	1*											1	1			Dog	75	+
71	Apr 8	Dr. M. E. Bushey	Arlington	Sibley	5	3* 2§											1	1			Dog	76	+
72	Apr 17	Dr. J. G. Annand	Sand Creek	Scott					2	2	?	17			2	2	?	1					
73	Apr 24	Dr. W. S. Leach, H. O.	Brooten	Stearns													5	5					
74	May 28	Dr. E. E. Brubaker, H. O.	Northfield	Rice	1	1*a											3	3			Dog	77	+
75	June 2	Mr. H. A. W.	Clearwater	Wright					?	1	?	1					?	1					
76	May 24	Mr. E. S. Wiggins, C.B.S.	Rogers	Hennepin					?	8	?	39					?	4			Hog	78	+
77	July 4	Dr. H. I. Grivelly	Waconia	Carver	1	1*					1	1					2	2					
78	July 9	Dr. E. W. Cooley	Blooming Prairie	Steele	1	1*											1	1					
79	July 20	Dr. S. D. Brimhall	Annandale	Wright					1	1	7	7					6	6					
80	Aug 5	Drs. Brimhall & Wesbrook	Kiester	Faribault					3	3							1	1					
81	Aug 15	Mr. E. A. Hart, C. B. S.	Maple Lake	Wright					?	5							?	4					
82	Aug 14	Dr. J. G. Annand	Dexter	Mower					?	2							?	5			Cow	79	?
83	Aug 20	Mr. N. A. Fredricson, C.B.S.	New Market	Scott	2	1§ 1*a			?	6							?	2					
84	Aug 25	Dr. H. O. Smith	Shakopee	Scott													2	2			Dog	80	?
85	Oct 14	Dr. E. Y. Chilton	Granite Lake	Wright					?	2	?	4					6+	6+		1			
86	Oct 20	Mr. O. T.	Comfrey	Brown					?	3													
87	Oct 14	Dr. J. W. Robertson	Litchfield	Meeker	1	1§	?	1									?	1			Horse	81	+
88	Oct 26	Dr. T. W. Hovorka	Silver Lake	McLeod	7	1† 6*											?	3					
89	Nov 1	Dr. C. C. Lyford	Osseo	Hennepin					1	1							1	1			Calf	82	+
90	Nov 1	E. Williams, T. C.	Bear Lake	McLeod							2	2					1	1					
91	Nov 17	Dr. E. A. Woods	Becker, Clear Lake, Palmer	Sherburne	1	1*b			?	3							?	□ 9			Dog	83	+
92	Nov 24	Dr. S. D. Brimhall	Middleville	Wright						7							1	1			Cow; Cow's Milk	84; 84a	+; —
93	Oct 22	Dr. J. M. Rains, H.O.	Lake Lillian, Lake Elizabeth, Willmar, Rosebud, Fahlun	Kandiyohi	1?	1§	2	2	3	3			2	2			?	16					
	1903																						
94	Jan 5	Dr. G. E. McCann	Hermann	Grant	2	2*											?	7			Dog	85	+
95	Jan 14	Dr. A. A. Rankin	Clara City	Chippewa													?	6+			Dog	86	+

96	Feb	20	Dr. R. P. Storey	Grey Eagle	Todd	.....	.....	.....	.....	1	1	11	11	.....	.....	.....	.....	4	4	.....	..	Cow Hog	87 88	+ ?
97?	Feb	24	Dr. G. R. Moloney	Belle Plaine	Scott	(2)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	(1)	Cat	89	—
98	Feb	24	Mr. A. Wilmerding	Freeport	Stearns	.....	.....	.....	.....	.....	.....	?	2	.....	.....	.....	.....	1	1	.....	.....	.....	.....	....
99	Feb	27	Dr. S. C. Borom	Clinton	Bigstone	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	?	6+	.....	...	Saliva	.....	....
100	Mar	4	Dr. Robt. Williams	Alden	Freeborn	.....	.....	?	.....	?	.....	.....	.....	.....	.....	.....	.....	?	6+	.....	...	of Dog Dog	90 92	? +
101	Mar	9	Dr. D. M. Cool	Faribault	Rice	.....	.....	.....	.....	.....	.....	?	7	.....	.....	.....	.....	?	1	.....	.....	Hog	91	+
102?	Apr	9	Mr. A. E. C.	Cedar	Anoka	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	(1?)	.....	.....	.....	.....	....
	Total number of persons		untreated except cauterization.		Died	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
					No Symptons	.....	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
			received pasteur treatment		Died	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
					No Symptons	.....	29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
	Totals					41	41	5+	5	154+	154	109+	109	2+	2	2	2	198+ Wolf	198 1	.....	1	.....	.....	....
104	Total number Cases of Rabies				478																			

* Treated. No symptoms.
*a. Treated but not included in Chicago report. No symptoms.
*b. Died—Treatment began late.
† Died of Rabies. Untreated.
§ Wounds thoroughly cauterized. No symptoms.

LIST OF PATIENTS FROM MINNESOTA TREATED IN PASTEUR INSTITUTES, CHICAGO, 1896-1903, AND NOT INCLUDED IN TABLE I.

1896.

1. J. H. S., 39 years, from Glenwood, Minn, bitten by dog January 17th.
2. W. W. F., 8 years, from Glenwood, Minn., bitten by dog February 22nd.
3. R. W., 37 years, St. Paul, Minn., bitten by dog March 10th.
4. F. M., 38 years, from Jordan, Minn., bitten by dog June 13th.
5. Mrs. S. J. K., 73 years, from Austin, Minn., bitten by dog June 4th.
6. A. R., age 45 years, from Heidelberg, Minn., bitten by shepherd dog December 14th. Two rabbits inoculated in laboratory, December 20th, died January 13th.
7. J. S., 16 years, from New Prague, Minn., bitten by same dog December 15th. These last two patients were sent by Dr. E. E. Novak of New Prague.

1897.

8. G. O., 8 years, from Maple Lake, Minn., bitten by dog August 10.

1899.

9. E. H. A., 46 years, from Minneapolis, Minn., bitten by dog June 10th.
10. F. P., 43 years, from Minneapolis, Minn., bitten by dog June 9th.
11. H. L. D., 12 years, from Minneapolis, Minn., bitten by dog June 4th.
12. H. L. D., 9 years, from Minneapolis, Minn., bitten by dog June 9th.
13. H. N. C., 32 years, from Minneapolis, Minn., bitten by dog June 10th.
14. N. F. S., 29 years, from Minneapolis, Minn., bitten by dog June 10th.
15. H. C., 4 years, from Minneapolis, Minn., bitten by dog June 10th.
16. W. P., 14 years, from St. Paul, Minn., bitten by dog Sept. 8th.
17. A. J. G., 26 years, from St. Paul, Minn., bitten by dog Sept 8th.
18. J. D., 11 years, from St. Paul, Minn., bitten by dog Sept. 8th.
19. H. B., 44 years, from Minneapolis, Minn., bitten by dog Sept. 8th.
20. M. G., 38 years, from Robbinsdale, Minn., bitten by dog Sept. 8.
21. A. W., 13 years, from St. Paul, Minn., bitten by dog Sept 8th.

1900.

22. R. S., 13 years, from Minneapolis, Minn., bitten by dog March 25th.
23. F. H., 17 years, from Minneapolis, Minn., bitten by dog March 25th.
24. J. P., 7 years, from Minneapolis, Minn., bitten by dog March 25th.
25. L. P. D., 46 years, from Minneapolis, Minn., bitten by dog June 30th. The dog died rabid, and was diagnosed by Dr. Cotton.
26. H. M., 11 years, from Minneapolis, Minn., bitten by same dog June 29th.

1901.

27. G. B. N., 36 years, from Minneapolis, Minn., bitten January 20th, by dog which died rabid; so diagnosed by a local veterinarian.
28. E. O., 18 years, from Minneapolis, Minn., bitten March 29th, by dog which was pronounced rabid, and was killed the next day with well defined symptoms of rabies.
29. R. P., from St. Paul, Minn., had saliva of a rabid dog infect face and eyes on April 17th.
30. J. D. B., 2 years, from Leota, Minn., bitten by dog April 23rd, which in two days died of rabies.
31. M. A., 2 years, from Minneapolis, Minn., bitten by dog May 1st. Rabbits and guinea pigs inoculated have confirmed the diagnosis of rabies.
32. R. S., 7 years, from St. Paul, Minn., infected on the face June 15th. Diagnosis of rabies on dog made by Richard Price, City Veterinarian.
33. J. S. M., 34 years, from St. Paul, Minn., bitten June 5th, by rabid dog, so pronounced by Dr. Richard Price. Two weeks afterwards a goat, also bitten by same dog, developed rabies, diagnosed by Dr. D. A. Pomeroy.
34. D. A. L., M. D., 46 years, from Minneapolis, Minn., bitten by dog August 6th.
35. R. L., 6 years, from Minneapolis, Minn., bitten severely on face by a strange dog October 21st. On November 30th, the boy developed hydrophobia and died.*

1902.

36. Mrs. A. E. S., 40 years, from Minneapolis, Minn., bitten by dog January 9th.
37. C. L., 10 years, from Minneapolis, Minn., bitten by dog about January 28th. Inoculation experiments on rabbits gave positive results.
38. N. K., 21 years, from Eidswold, Minn., bitten by dog January 29th.

1903.

39. A. S. A., 28 years, from Herman, Minn., bitten February 20th, by a horse with fully developed rabies.
40. E. B., 15 years, from Herman, Minn., bitten February 20th, by a horse, as above.
41. H. O. S., 34 years, from Springfield, Minn., bitten March 8th, by dog affected with dumb rabies.
42. M. S., 32 years, from Springfield, Minn., bitten March 8th, by dog, as above.
43. E. S., 3 years, from Springfield, Minn., bitten by dog February 28th.
44. E. B. H., 5 years, from St. Paul, Minn., bitten by dog March 31st.

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*The post-mortem diagnosis of this case by the Minneapolis health department was "*Diphtheria.*" The child was sick but two days and had no medical attendant. An autopsy was not permitted.

The above table gives a list of the outbreaks of rabies concerning which data has come officially to the Board. It does not pretend to be a complete statement of all the outbreaks of rabies, and certainly not of all the cases which have occurred in this state during this period. Unofficial information has been received concerning many cases of which the Board had no official record and these have not been included, nor have those mentioned above as occurring prior to 1896.

This table shows that the disease has been widespread in Minnesota, and from it one may gain some idea of the loss to the state which has resulted from rabies. On account of the paucity of information, the following estimate is very much lower than it should be. It requires no discussion.

ESTIMATE OF LOSS TO MINNESOTA FROM RABIES, 1896-1903.

*7 People (Dead)	at	$5,000	$35,000.00
30 People, Pasteur treatment (See Table I)			
44 People, Pasteur treatment (Chicago Record)	at	200	14,800.00
5 Horses	at	100	500.00
154 Cattle	at	40	6,160.00
109 Hogs	at	10	1,090.00
2 Sheep	at	3	6.00
2 Goats	at	5	10.00
198 Dogs	at	5	990.00
1 Cat	at	......	....
			$58,556.00

Apart from the commercial aspect of this disease, where human beings are exposed to infection, the public and private state of mind must be considered. It is impossible to express this in terms of dollars and cents.

The Board has certain knowledge therefore, as indicated in Table I, that 85 people have been exposed to infection with rabies virus. Of these seven have died. Sixty-eight have shown no symptoms. This is accounted for by the fact that 74 out of the 85 were given Pasteur treatment. Only two of 85 people who received Pasteur treatment developed symptoms of the disease. In

*In Table I. only six deaths are reported, but the Chicago record showed another fatal case—No. 35—concerning which no official report had been made to this board. Of the thirty cases reported as having received Pasteur treatment only twenty-eight were included in the Chicago record, although the local authorities stated that these two cases had been sent, the name of the institute not having been given. This means then that at least seventy-four patients from this state were treated during this period.

one case, the reason for the apparent failure of the treatment was on account of the fact that it was not begun until six days after the patient had been very severely bitten on the face, the location of the bite being an important factor. As noted by the Director of the Pasteur Institute, the virus was of exceptional strength, symptoms of the disease appearing in 15 days and death occurring on the 16th day. No surgical treatment was given this patient until several hours after he was bitten, during which time he followed the rabid dog until he killed it. The attending physician believed that the vigorous exercise helped materially in the early and wide distribution of the virus. In the other fatal case it is not at all certain that the patient died of rabies, it having been reported as diphtheria. (See No. 35 Chicago record.)

Of 11 individuals bitten by rabid animals, but receiving no Pasteur treatment, five died from rabies and six developed no symptoms of the disease. In none of these six were the wounds received upon an unprotected surface. The clothing doubtless protected them from inoculation with the virus in the saliva. In two of them the wounds were very slight, and in all the six cases prompt surgical treatment was rendered.

How the Disease is Distributed and Remedies Therefor. The great variety of animals infected with rabies include not only domestic animals, but one wolf, and suspicion has been attached in at least two instances to the skunk as a means of starting these outbreaks. A fact which is worthy of some comment is that of the 110 hogs reported here as having been bitten by rabid animals, so far as can be ascertained, in only one instance did the symptoms of rabies fail to develop. In the report of this case, mention was made that the animal was only slightly scratched. This apparent susceptibility is of some importance, since hogs are rather vicious animals, and although usually confined in close quarters may be instrumental in the spread of the disease amongst their kind if not to other animals or man.

From the detailed reports and the table, it will be seen that rabid horses always tried to bite and were successful in injuring human beings in several instances. They have to be considered in the spread of the disease.

No attempt has been made to estimate the loss in poultry, although in many outbreaks this was considerable. Usually chickens or other such animals are immediately destroyed by the rabid dog, and they cannot be considered therefore, in relation to the infection of other animals.

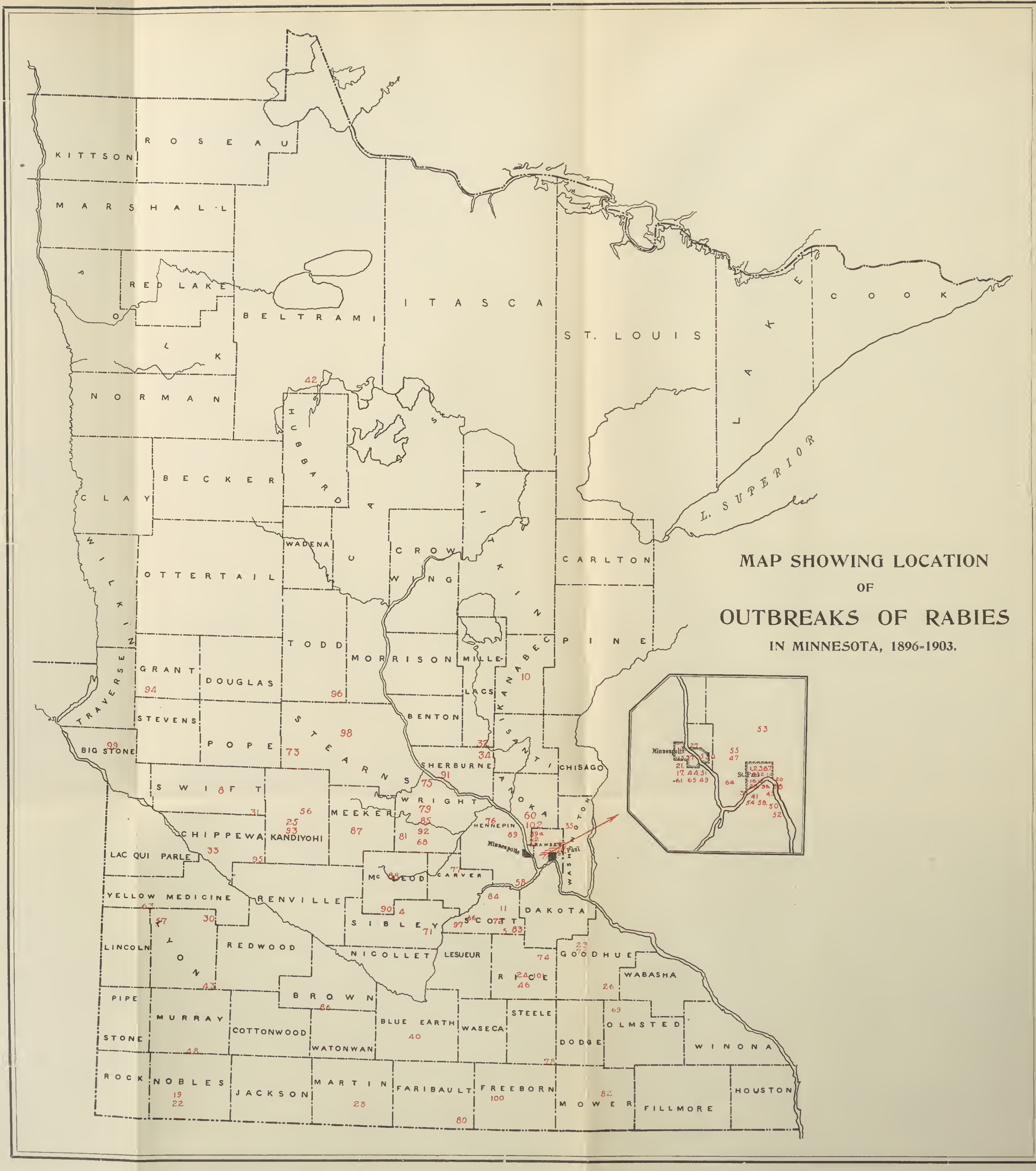
Cows may also be excluded from the list of animals playing an important *role* in the distribution of infection, although it should be noted that people who have the care of the animals may be exposed to possible infection by milk, or in the attempt to give medicine, or when in any way there is danger of abraiding the skin and permitting the entrance of fluids containing the virus.

The dog is undoubtedly the chief factor in the spread of infection. In many of the outbreaks, notably Nos. 58 and 93, there are very complete and detailed histories which show that many animals or people may receive infection from one dog, even though they be widely separated, since these animals frequently run many miles.

In relation to the prevention of the disease, very strict measures should be adopted throughout this state. It has been suggested that a high license be established, and that all unlicensed dogs be destroyed by the local authorities, and if it be possible to ascertain the owners of such animals, that they be fined. The funds derived from the license and fine should be utilized for the payment by the state of damage resulting from dogs, including Pasteur treatment for bitten persons. Such measures would result in the destruction of ownerless curs, which for the most part seem to have been responsible for the epidemics in this state. The high license would probably initially increase the number of ownerless curs until they had been properly disposed of. If, after a proper trial of these measures, the disease be not stamped out, by the addition of a general law compelling the muzzling of all dogs, the elimination of this disease may be secured, as in those countries in which it has been in vogue. The muzzling order would be very difficult indeed to enforce in this state unless it were shown that no other method would answer the same purpose. In those countries where muzzling ordinances have been so markedly successful, there are practically no ownerless dogs, owing to the previously existing and rigidly enforced taxation system.

This matter received some discussion at the Minnesota Sanitary Conference, held January 14th and 15th, 1902. (See 19th report Minnesota State Board of Health, p. 90.)

There is a widespread belief that skunks are frequently responsible for the distribution of rabies, and in more than one of the outbreaks here reported there seems to be a basis for that belief. In the outbreaks referred to, the dogs exhibited wounds which were presumably made by skunks and within the usual time developed undoubted symptoms of rabies, which were verified by laboratory examination of them or animals infected by them.



MAP SHOWING LOCATION OF OUTBREAKS OF RABIES IN MINNESOTA, 1896-1903.

In the case of wolves, skunks or other wild animals, there is probably little to be feared, however, if provision be made for the prevention of the spread of the virus by dogs.

Geographical Distribution of Rabies in Minnesota. Amongst the earliest reports of the existence of rabies in this state were cases in the vicinity of St. Paul and Minneapolis. With the progress of the investigation it has been found that by far the greater number of outbreaks and cases have occurred in this neighborhood, and certain of the outbreaks at considerable distances from these cities have either been traced directly to rabid animals which started from the Twin Cities, or there has been reasonable ground at least for suspecting these localities as the original sources. The accompanying map shows the location of those outbreaks which have been reported officially to the Minnesota State Board of Health, and it will be seen that the northern part of the state is, comparatively speaking, free from this disease. Either the Twin cities have served as foci from which the disease has emanated from time to time, or the facilities for reporting cases and the presence of a larger proportionate number of veterinarians has led to more careful investigation and record of cases in their vicinity.

An important factor in the recognition of cases in these localities has been the stand taken by Dr. Richard Price, who made every endeavor in the earlier years to investigate all suspicious cases. His work resulted not only in the report of a great many cases by himself, but undoubtedly stimulated others to more careful investigation.

Considerable difficulty has been experienced in securing accurate data concerning the source of infection, the number of animals bitten and their fate. In 1892, there was issued from the office of the Secretary and Executive Officer of the Minnesota State Board of Health, a circular on rabies asking for information of suspicious cases and giving hints as to the necessary steps in the treatment of wounds and the diagnosis of the disease.

It was found necessary to modify this circular so as to aid in the securing of information and to arouse a proper spirit of cooperation in relation to diagnosis of the disease and prophylaxis. Accordingly on Aug. 15, 1899, another circular was issued which reads as follows:

Rabies (Hydrophobia). The investigations *conducted in the bacteriological laboratory of this Board during the last three years

*Report of the Minnesota State Board of Health, 1895-98.

have shown that rabies is much more prevalent in Minnesota than was formerly thought to be the case, though it is believed that it is not so prevalent as might be inferred from local newspaper reports. It is desirable, therefore, to know how many of these supposed cases are really rabies in order that:

(*a*). If the wrong diagnosis has been made, the fears of the community and of persons bitten or owning bitten animals be allayed.

(*b*). If the clinical diagnosis be correct, proper protective and curative measures may be taken in time.

The Duties of the Local Health Officer in a Case of Supposed Rabies:

1. Do not kill the suspected animal, but if possible secure it alive and without injury. Confine it in a safe, quiet, roomy and comfortable place.

2. Report full particulars to the Secretary of the State Board of Health, St. Paul, Minn.

3. Secure and keep under observation (*i. e.* quarantine) all animals known to have been bitten.

4. Keep the supposedly rabid animal under the observation of a competent veterinarian for at least 10 days. (If the animal does not die within eight days from the onset of symptoms, the disease is probably not rabies).

5. If the animal dies or has to be killed for any reason before or during confinement, care should be taken not to injure the brain or spinal cord.

6. The disease may or may not have been rabies, but an accurate diagnosis may usually be made by the laboratory if the following directions are observed:

(*a*). Cut off the head and several inches of the neck of the animal.

(*b*). Do not permit any antiseptic to come in contact with the specimen.

(*c*). Place the head in a piece of new oil cloth, or waterproof material, gather up the corners and edges so as to form an improvised bag and tie tightly so as to prevent all possibility of the escape of fluids. Place in a water-tight box or tin vessel. If in freezing weather, freeze the head and keep it frozen, if possible, until it can reach the laboratory or until it is placed in the express car. If it cannot be frozen, pack the water-tight box in a large quantity of

ice and dry saw-dust in a second box. If it is impossible to freeze the head or to secure ice for packing, the brain and upper portion of the spinal cord should be removed in as aseptic a manner (without the use of antiseptics) as possible, and placed at once in pure glycerine in a clean sterile glass vessel.

(*d*). Whatever the method of preparation, the box containing the specimen should be labeled as follows: Bacteriological Laboratory, Minnesota State Board of Health (State University), Minneapolis, Minn.

(*e*). Ship by express prepaid.

(*f*). Send to the laboratory (see above address) by mail, special delivery, all data obtainable.

When specimens are received, susceptible animals, usually rabbits, are inoculated under the skull and kept under observation. Positive diagnostic symptoms appear usually, if at all, in from three to six weeks.

If from any cause, such as improper method of killing the animal or packing the head, delay in shipping or during transit, the brain and spinal cord become contaminated or decomposed, the material on injection may produce a meningitis, resulting in the death of the inoculated animal before symptoms of rabies have had time to appear. It is, therefore, necessary that the above steps be taken as soon as possible after the death of the animal.

Treatment of Patient. It is the duty neither of the local board nor of the State Board of Health to prescribe treatment, but the following suggestions may be of value:

1. Promote free hemorrhage from the bite by use of a warm bath or warm, moist fomentations.

2. Use antiseptic dressings.

3. Use all vigilance in dealing with the case, but at the same time allay the fears of the patient and friends. Less than 17 per cent of people bitten by mad animals die of rabies, and after treatment by Pasteur's method, the mortality is less than 1 per cent.

4. If the biting animal has been killed, or has died, after exhibiting symptoms of rabies, no time should be lost in sending the bitten person to a Pasteur Institute, of which there are several in this country.

Precautionary Measures. Since rabies is ordinarily spread by means of dogs, more careful surveillance of these animals would appear advisable.

All owners of dogs should be required to register them and provide them with evidence of the fact by collar and tag.

On the appearance of rabies in a community, all dogs should be muzzled or safely confined.

When a dog or other animal is known to have been bitten by a rabid animal, it should be confined safely, but comfortably, for two months or longer, or destroyed as soon as the proof is furnished that the biting animal was rabid.

H. M. BRACKEN, M. D.,
Aug. 15, 1899. Secretary and Executive Officer.

In order to still further facilitate the collection of information of those cases which were investigated in the laboratory, and still more on account of cases concerning which no information was received until it was too late for either clinical or laboratory investigation, another circular was issued in 1902. By means of this, it was hoped that a full history of the outbreak could be obtained, the original source located and all the animals, as well as people, who were bitten and their ultimate fate ascertained. However, in this disease, it is most difficult to obtain full histories and to know exactly the relationship of the various outbreaks which occur in any community.

In the preparation of these tables, maps, etc., it has been found necessary to go through a very great deal of correspondence, and it frequently happened that even after a prolonged investigation and full report thereon, further information concerning the fate of the bitten animals and the development of the disease in that locality could not be obtained.

Seasonal Distribution. Of 92 outbreaks of rabies diagnosed in Minnesota, it has been found impossible to obtain an accurate idea of the months of the year in which the most cases develop, owing to the fact that after the initial case in any particular outbreak, others subsequently developed from time to time, sometimes during several months. Only in the case of those animals which were investigated through the Veterinary Department or where specimens were reported upon in the laboratory, was it possible to know the date of the appearance of the disease.

The following is a table of these observations:

TABLE II. SHOWING DISTRIBUTION OF OUTBREAKS, BY MONTHS, OF RABIES IN MINNESOTA, 1896-1903.

In January, 5 outbreaks have begun.
In February, 16 outbreaks have begun.
In March, 7 outbreaks have begun.
In April, 6 outbreaks have begun.

In May, 6 outbreaks have begun.
In June, 3 outbreaks have begun.
In July, 6 outbreaks have begun.
In August, 10 outbreaks have begun.
In September, 2 outbreaks have begun.
In October, 13 outbreaks have begun.
In November, 11 outbreaks have begun.
In December, 7 outbreaks have begun.

A minute discussion of Table II. is unnecessary, as it is impossible to know anything further than that the outbreaks of the disease have not been more common in the heated months than in cold weather. Too few outbreaks, however, have been observed to warrant any general conclusions.

Methods Employed for Diagnosis. In these investigations, the history of the disease has proved of great value in diagnosis. In many cases, as will have been seen from the detailed reports, it has afforded a complete basis for diagnosis. Wherever possible the laboratory has been utilized for establishing or corroborating the diagnosis. The method usually employed in the laboratory has already been described under the circular of information, and it may be stated that subdural inoculation of rabbits with an emulsion of the cord, medulla or brain of the affected animal has proven very satisfactory. Symptoms of rabies developed in the rabbits, as a rule, within two to three weeks. Where contamination of the material sent in for investigation has occurred, it has nevertheless, been found possible to render a diagnosis in many instances. It was surprising that bacterial meningitis did not more frequently develop in inoculated rabbits before there was time for symptoms of rabies. Where the material sent in for investigation is not fresh, it is wise to inoculate a second or even a third series of rabbits. When this is done, the micro-organisms, which are found present in the original material, in most instances disappear, so that when cultures are made from the nervous systems of the first pair of rabbits they are found to be sterile. Inoculation of this bacteriologically sterile material and the production of typical rabies symptoms renders a positive diagnosis certain. In one instance,* it was necessary after recognizing and identifying micro-organisms in the brain sent in for diagnosis, to neutralize the effects of the micro-organisms by antitoxic serum in order to demonstrate conclusively the presence or absence of rabies virus. The inoculation into the eye or the use of any other animals than the rabbit, has not been found necessary

*Page 474. Biennial Report Minnesota State Board of Health, 1899-1900.

in the laboratory diagnosis of this disease, nor has the microscopic examination of prevertebral ganglia been practised, owing to the uncertainty of the results thus far obtained by other observers, and the interpretation placed upon their findings. Furthermore, it has been impossible in a great deal of the material upon which diagnoses have been made to utilize this method, owing to the fact that considerable time had elapsed between the death of the supposedly rabid animal and the receipt of the specimen in the laboratory.

The length of time taken to diagnose this disease in the laboratory is not such a great drawback as at first sight appears, since where human beings are bitten, if they are to receive Pasteur treatment, it must be given immediately, and where animals have been exposed to possible infection they should be kept under very careful supervision.

In one instance the material forwarded to the laboratory for investigation consisted of saliva, but it was found impossible to obtain evidence of the presence of rabies virus, owing to the fact that the inoculated rabbits died with meningitis before a sufficient time had elapsed for the development of rabies.

On more than one occasion in this laboratory, milk from supposedly rabid cows has been inoculated subdurally, and in one case it was possible to show conclusively the presence of the rabies virus. In another case no discernible symptoms whatever resulted. The presence of rabies virus in milk is probably not very important unless the persons or animals partaking of it should have an abrasion in some exposed portion of the mucous membrane of the alimentary canal, since the digestive juices probably destroy the virus. In three instances rabid hogs were suckling litters of pigs during the period when they were exhibiting symptoms of rabies, yet in no case did any of the pigs develop the disease.

The usual period which elapses in rabid animals between the first evidence of symptoms and their death varies between three and eight days, but in one instance (outbreak No. 59, laboratory case No. 65) a period of almost 12 days elapsed between the onset of the disease and the death of the animal.

In one fatal case of rabies in a human being (outbreak No. 49, laboratory case No. 56) the virus was demonstrated in the brain seven hours after a thorough formaldehyde embalming by an undertaker.

The Pasteur Treatment of Rabies and the Necessity for the Establishment of a Pasteur Institute in Minnesota.

Too few cases have been included in this report to warrant the drawing of conclusions as to the value of the Pasteur treatment for rabies. The results have been already given in Table I. and commented upon. The efficacy however, of the Pasteur treatment has been too well demonstrated to require vindication.

This report includes 74 persons who have received the Pasteur treatment and 11 to whom it should have been given. There are doubtless many other individuals who should have received the treatment since 1896. Many animals have been lost, and some of them of considerable value.

It would, therefore, appear, in view of the widespread distribution of this disease and the necessity for immediate treatment, where treatment is required at all, that there should be established in Minnesota a Pasteur Institute under the direction of the State Board of Health or the State University.

This is a disease which affects both men and animals, and no apology is therefore necessary for here reporting the cases of human rabies, since rabies is a disease which must be studied both from the human and veterinary view points.

SUNDRY DISEASES OF HORSES.

Furunculus—*Minneapolis.*—April 3, 1901, Dr. C. C. Lyford of Minneapolis brought to the laboratory a small piece of tissue got from around a freshly opened suppurating point in the coronary band of the hoof of a horse. The ointment jar containing the specimen had a layer of vaseline in the bottom, though the jar had supposedly been cleansed and rinsed with methylated spirits. Direct coverslip preparations stained with eosin and methylene blue showed short chains of cocci, many of which were in pairs and many within the cells. No other organisms were found in direct coverslip preparations. Twenty-four-hour serum cultures showed staphylococci and short bacilli somewhat resembling diphtheria bacilli. (Types E. D. E^1. A. A^2. G.) (See p. 636, 18th biennial report Minn. State Board of Health.)

Infectious pneumonia—*St. Cloud, Stearns Co.*—Case 1. Sept. 27, 1901, there was received in the laboratory through Dr. C. C. Lyford, of Minneapolis, two test tubes which contained about 7 c. c. each of blood collected by him the previous day at autopsy on the body of a horse, the property of Mr. N. P. C. of St. Cloud. Direct coverslip preparations and cultures were made and examined. A number of bacteria of various kinds were found.

Case 2. On October 1st, there was received in the laboratory through Dr. Lyford, from Dr. S. H. Ward, of St. Cloud, six test tubes containing (a) portion of lung; (b) portion of heart wall; (c) portion of spleen; (d) portion of liver; (e) some pericardial fluid, and (f) heart's blood.

Case 3. October 4th, Dr. Wilson visited the farm of Mr. N. P. C., near St. Cloud, Minn., in company with Dr. S. H. Ward and made an autopsy on the body of a horse dead 24 hours. The animal showed intense pneumonia and pericarditis. Decomposition was well advanced. The results of all of the examinations were summed up in the following report to Dr. Ward:

Dr. S. H. Ward, St. Cloud, Minn.

My Dear Doctor Ward: We have to make a preliminary report on examinations made by Dr. L. B. Wilson, of the specimens received from the horses of Mr. N. P. C., St. Cloud, Minn. The specimens received through Dr. Lyford from the first horse were too badly decomposed for examination, but

the specimens from the second horse brought by Dr. Lyford on Sept. 30, have been examined with the following results:

In direct coverslip preparations and also in cultures from the lungs, pericardial fluid and heart's blood, were found small Gram-staining diplococci, frequently appearing intracellular in lung specimens, and in fluid media growing out into chains of from 6 to 12 individuals. In all examinations it resembled diplococcus pneumoniæ.

The specimens from the third horse collected by Dr. Wilson, at autopsy performed by you showed the same microbe in coverslip preparations and cultures from both the lungs and pericardial fluid. Associated with this microbe in cultures from all tissues and fluid examined in both animals, except the lung in horse 2, were the diplococcus occuring in pure culture or in a mixture of *bacillus coli communis* and various putrefactive bacilli. This was due to the length of time which had elapsed between the death of the animal and the bacteriological examination, and it is unlikely these latter micro-organisms have anything to do with the disease. That the diplococcus is related to the pneumonia and pericarditis clinically diagnosed by you and demonstrated in your autopsies, would seem probable. Should any of the other animals now sick afford an opportunity for a bacteriological and pathological examination soon after they are dead, we shall be glad to be present and collect material and go over the matter with you. This, however, Dr. Wilson told you on his visit, Oct. 1. If there is any other way in which we can throw light upon the matter, please command us.

F. F. WESBROOK.

Purpura hemorrhagica—October 15, 1901, Dr. Brimhall made an autopsy on a black horse, the property of Mr. J., Minneapolis, Minn. The horse had been suffering from acute laminitis for several weeks. The animal was killed because of a complication of *purpura hæmorrhagica* which debilitated the animal so rapidly that he was unable to stand. At autopsy found a number of local exudates into the skeletal muscles, also petechiæ on mucous membrane of the nose. One of the affected areas was opened and another one was dissected out and taken to the laboratory.

Direct coverslip preparations stained with eosin and methylene blue were examined, but no bacteria were found. Cultures were made in broth and on serum. After 24 hours in the incubator a small colon-like bacillus was found unmixed with other organisms in both broth and serum cultures.

Oct. 17, 1901, rabbit No. 456, weight 1,265 grammes, was inoculated in the posterior vein of the left ear first with three cubic centimeters of emulsion of a plain broth and a plain serum culture of the bacillus noted above. The rabbit was found dead on the morning of Oct. 21. At autopsy the brain was found to be pale. The heart contained very purulent blood. The blood itself was thin and dark. The spleen was swollen and dark. Liver darker in color than

normal and bled freely on section. Kidney was congested. Direct coverslip preparations and cultures were made from the heart's blood, spleen, liver and brain. These showed bacilli which on further examination proved to be *B. coli communis.*

Oct. 17, 1901, rabbit No. 457, weight 3,595 grammes, was inoculated in the posterior vein of the left ear with 0.5 c. c. of an emulsion of a plain broth and a plain serum culture of the organism noted above. The animal having shown no symptoms up to Jan. 2, 1903, it was used for another purpose.

Bursatti—*Minneapolis.*—Aug. 7, 1902, Drs. Brimhall, Lyford and Wesbrook collected specimens from a horse which had been suffering from bursatti for several years, according to Dr. Lyford's account. The animal was a bay horse, infected over the right hip in an area about 10 inches in diameter, extending from close to the spine down over the hip irregularly, as also another focus of infection near the inner canthus of the right eye. The diseased area was covered with a dry crust, underlying which the surface was pitted in places, and when the crust was removed there was a continual escape of the sero sanguinous fluid. The skin was infiltrated and thickened to a depth of about one inch. A portion of the crust near the margin of the area over the right hip was removed, and a small superficial area was seared with a hot iron and broth inoculated by means of a hypodermic needle which was placed into the lower layers on the skin. Three such cultures made from this area and two from a point just beneath the right eye. A piece of tissue about 1 cm. square was removed from the lower margin of the hip lesions. The piece was about 0.5 cm. in depth. It was placed immediately in Zenker's fluid. After 24 hours in the incubator two of the broth cultures from the hip showed apparently no growth. One culture showed a short thick motile bacillus and staphylococci. One of the cultures from the eye showed no growth, the other a few long slender motile bacilli and many short narrow diplococci or bacilli. Subsequent cultures from this culture showed these latter organisms to be staphylococci or streptococci. The histological study of the tissue showed round celled infiltration and an appearance not unlike sarcoma. It was the intention to study further cases of this disease.

Sore Throats.—Aug. 21, 1902, Dr. C. C. Lyford of Minneapolis, sent to the laboratory a tracheotomy tube which he had removed

from a pony which had exhibited symptoms of severe sore throat. Direct coverslip preparations and cultures showed staphylococci and *B. coli communis.* No diphtheria-like bacilli were present.

Meningitis (?)—*Montevideo.*—March 30, 1903, there was received in the laboratory from Dr. T. Lambrechts of Montevideo a bottle containing three pieces of spleen and two pieces of liver. On the following day there was received the following information, being a copy of a letter from Dr. Lambrechts:

Montevideo, March 28, 1903.

Dr. S. D. Brimhall, St. Paul.

My Dear Doctor: I sent to-day to Dr. Wesbrook specimens of liver and spleen of a horse that died here from an unknown disease. On the same farm three others have died (from the same cause, similar symptoms). The most common of these symptoms was paralysis.

On post-mortem nothing abnormal could be found. These horses were all fed millet hay.

Please inform me as soon as possible as to the cause.

Very truly,

T. LAMBRECHTS.

Direct coverslip preparations from the spleen stained with eosin and methylene blue showed many bacilli. Cultures in broth and on serum showed yellow and white staphylococci and an abundant growth of *B. coli communis.* Since the specimens had not been removed with aseptic precautions and were all in the same bottle, and since decomposition had already set in when they were received in the laboratory, the bacteriological findings above noted cannot be considered as of any etiological significance. It is possible that the disease affecting these horses may have been meningitis, but the evidence is insufficient to warrant such a diagnosis.

"SWAMP FEVER" IN HORSES

Introductory.—For more than twenty years in Manitoba, a very fatal though chronic disease in horses characterized by progressive wasting and anæmia, and accompanied by periodic pyrexia, voracious appetite and a characteristic "wobbling" gait has been well recognized. From the common name "swamp fever" it may be inferred that an etiological relationship between low-lying land, or the use of coarse native hay cut from swamps, and the disease has been suspected. Various explanations have been suggested, among them the unknown virus has been supposed to be carried by the water during periods of inundation and left after its recession in the grass around the border of the marsh. The eating over such pasture, or the use of hay cut from such a source, has been looked upon by many as the most probable means of transmission of the disease, although whether the virus is chemical or is really an animal or bacterial parasite has not been stated. The name "malaria in horses" is expressive of a belief in the periodicity of the accompanying fever and suggests the possibility of a blood parasite and a relationship to mosquito, fly or insect bites. This phase of the question has been thoroughly investigated by Drs. Bell and Torrance,[1] and frequent and persistent blood examinations in all stages of the disease—specimens having been collected at all hours of the day, as well as night—have failed to reveal anything in the nature of a plasmodium. "Surra"[2] is likewise thus excluded, as nothing resembling *trypanosoma Evansii* has ever been encountered in the blood, nor has the "*piroplasma equi*"[3] been seen. A common name in Western Canada, "pernicious anæmia in horses," is indicative of the progressive and marked hæmal changes which are to be observed in the disease, although the nucleated red blood cells and the poikilocytosis which characterize this condition in human beings have not been observed.

1"Malarial Fever in Manitoba"—F. Torrance—Proceedings of the American Veterinary Medical Association, 1902, page 282, *et seq.* Also Veterinary Journal and Annals of Comparative Pathology, July 1899, Taylor.

2"Emergency Report on Surra," by Salmon and Stiles—Bureau of Animal Industry. Annual Report (18th), 1901, p 41 *et seq.*

3"Contribution a l'etude de *Piroplasma equi.*" Laveran. Comptes rendus hebdomadaires des Seances et Memoirs de la Societe de Biologie, p. 385.

For many years in Iowa, Nebraska and Dakota, a very fatal sickness in horses, known as "bottom disease,"[4] has existed, being apparently more prevalent in the low-lying lands along the Missouri river and assumed by some to be due to eating the plant known as "rattle box" (*Crotalaria saggitalis*). From the descriptions given it is impossible to say with certainty whether this is the same disease or not, although it would appear to be somewhat similar to swamp fever in its manifestations and course.

It is uncertain whether, in his "Pasteurellose equine," Lignières[5] includes this condition.

The European researches of Dieckerhoff,[6] Schütz,[7] Galtier and Violet,[8] and others leave us in doubt, as to the relationship of typhoid fever (*pferdestaupe*), infectious pleuro-pneumonia (*brustseuche*) and influenza (*scalma*). In connection with these diseases a cocco-bacillus (*bacille ovoide*) and certain varieties of streptococci and diplococci have been described. Lignières, endorsed to some extent by Nocard and Leclainche[9] has attempted to simplify the study of these affections by grouping them under "Pasteurellose equine." This group, he subdivided into:

1. Septicaemic form (typhoid fever, influenza).
2. Acute or subacute forms with all their localizations (contagious pneumonia, gastro-enteritis).
3. Chronic form (progressive pernicious anæmia).

Lignières believes that these widely divergent types of disease are all due to an ovoid bacillus (bi-polar) of the hæmorrhagic septicæmia group. He takes it for granted that where the bacillus is not recovered from the tissues of horses which have succumbed to these diseases, it has been initially present, and after undermining their resistance, the streptococcus of Schütz or some other bacterium has been responsible for the production of the final symptoms and death of the animals. In support of this hypothesis, he advances the result of artificial inoculation of this ovoid bacillus into horses where after the production of symptoms of typhoid and

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4"Bottom Disease" among horses—E. C. Schroeder; U. S. Bureau of Animal Industry Reports, 1891-92, p. 371 *et seq.* Also First Annual Report of the State Veterinary Surgeon of the State of Iowa, 1885, p. 16 *et seq.*

5Bulletin de la Societe Centrale de Medecine Veterinaire—Paris. June 1 and July 22, 1897—Dec. 30, 1898, and July, 1900.

6Dieckerhoff—"Die Pferdestaupe." Berlin, 1882.

7Schütz—"Uhrsache der Brustseuche der Pferde"—Archiv für Thierheilkunde, Vol. XIII, 1887, p. 27.

8Galtier et Violet—"Les pneumo-enterites infectieuses des fourrages." Paris, 1890—Galtier, "Traite des maladies contagieuses," Dieuxieme Edition, Vol. II, 1892, p. 649.

9Nocard et Leclainche, "Les Maladies microbienne des Animaux."—Dieuxieme Edition, Paris, 1898, p. 67 *et seq.*

death, he failed to recover from the tissues the same organism but found the "streptococcus of Schütz," which he believes to be a specific microbe differing constantly from streptococcus pyogenes (hominis). Observations on the disease "a frigore" in the dog are taken by him as corroborative of his assumptions concerning the etiology of the above mentioned group of diseases in the horse.

The grouping of diseases, clinically so ill defined, tends to obscure matters, and as already stated it is impossible to say whether the disease or diseases already mentioned as occurring in the United States and Canada (swamp fever, malaria in horses, pernicious anæmia, etc.) are included in his classification, and whether he has been able to show specifically for this disease a relationship to the bacillus of the hæmorrhagic septicæmia group.

Certainly in the absence of the very fullest clinical, bacteriological, pathological and experimental evidence it would seem difficult to believe that equine typhoid fever, the various pneumonias, influenza and "swamp fever" had a common etiology. In the mean time, the most careful study with full report in detail of individual cases is necessary before proceeding to any sweeping generalities.

There is then a disease or group of diseases described under various names in the western portions of Canada and in certain sections of the United States. In Manitoba the disease is responsible for the annual loss of many thousand dollars' worth of horses. Its prevalence may be gauged by the report of the loss by one railway contractor in a few months of more than ten thousand dollars worth of horses. Throughout the province, particularly along the valleys of the Red and Assiniboine rivers and in general in low-lying districts, the disease is found. Although by many it has not been deemed infectious, and there is no hesitation in the stabling of the diseased with well animals, such a menace to the welfare of the agricultural districts demanded attention. The Provincial (Manitoba) and later the Dominion Government authorities deemed the matter of such grave importance as to merit special investigation. The work primarily begun by Drs. Torrance and Bell on their own responsibility and at their own expense was extended by provincial and government aid, although it was carried forward under very great difficulties so far as provision for experimental work was concerned. The presence of the disease in localities conveniently accessible to headquarters (Winnipeg) enabled them to obtain very complete histories and to make frequent clinical and laboratory examinations. The clinical and pathological pictures presented in their reports

leave little if any room for doubt that the Manitoba disease is the same as that described in this report.

The etiology of the disease in Manitoba still remains in obscurity, since inoculations of fresh blood from clinical cases, and of cultures obtained at autopsy, have failed to reproduce the disease in horses, whilst no uniformity has been encountered in the bacteriological study of the cultures from animals sick or dead of the disease.

HISTORY OF THE DISEASE IN MINNESOTA.

For a number of years, the Veterinary Department of the Minnesota State Board of Health had heard rumors of the occurrence of a chronic disease in this state which was attributed by the farmers and owners of stock to the use of swamp hay or otherwise identified with grazing over and feeding from low-lying land. These rumors came largely from the northern part of the state in the districts around the Red and Red Lake rivers. From the vagueness of these rumors and the fact that there were relatively few veterinarians in the districts affected, the histories of the cases and other data concerning the disease, were derived from the owners of affected stock. Of necessity, there were many discrepancies in the reports received, all of which came in a roundabout way without specific requests for investigation.

It seemed to the board a very doubtful policy, when it had so much in the way of specific routine together with a number of investigations which had already been begun, to commence an investigation based largely upon rumors.

Being familiar however, with the fact that the disease was prevalent in Manitoba, knowing that it was under investigation there, and being in correspondence with the Manitoba investigators, this Board was on the alert for information relative to the disease in Minnesota since 1900. No direct information of cases for investigation could be obtained until the autumn of 1901. For some weeks prior to this time, through a misconcepton, requests for investigation were addressed to the State Experiment Station, under the mistaken impression that the State Board of Health Veterinary Department was located there. As a result, much delay ensued and the Board was blamed for apathy concerning cases of which it had no knowledge. After this work had been started, veterinarians and other observers throughout the affected districts in this state recalled the occurrence of seemingly the same disease for the past six years, and Dr. Langevin, of Crookston, believes that the disease

existed in the northern part of the state when he first came there something over twenty years ago.

Methods.—The rumors of this disease came principally from the northwestern portion of the state, that is, some three hundred miles or more from Minneapolis which rendered satisfactory laboratory work more difficult than it would otherwise have been. The experience of the board indicated that the only satisfactory method of investigating an unknown disease consisted in the personal visit of veterinary and laboratory representatives. Workers from these two departments were sent out fully equipped for the collection of data and clinical and laboratory specimens, as well as for laboratory investigation in the field. From the outset a firm stand was taken that investigations would not be done unless the owner of the sick horses was willing to afford opportunity not only for clinical investigation, but for post-mortem work. In spite of a very natural desire on the part of owners to have diseased animals treated, and the well animals protected, without regard to the diagnosis, the very high mortality of the disease rendered them skeptical of an ultimate cure and made them more willing to permit the killing of the animals.

Throughout the investigation, all interested persons have shown a spirit of co-operation which developed as soon as it became evident that steps were being taken to find out the cause of the disease and its means of transmission, with a view of preventing its spread, if a cure were found impossible. At first it was necessary to overcome the fatalistic idea which had arisen on account of the chronicity of the disease and its high mortality, many individuals believing that after an animal was infected, its death might be expected in due course.

Various theories as to the cause of the disease and methods of transmission were prevalent. On one or two occasions, after receipt of telegrams, representatives of the board went several hundred miles expecting to hold one or more autopsies, only to be requested to prescribe for the sick animals and to prevent the further spread of the disease. On pointing out that before curing or preventing the disease it was necessary to find out the active cause and the means by which infection was carried, no further difficulty was encountered, and every possible help was rendered on the part of those interested.

The initial difficulties met with were largely due to the great variety of clinical symptoms and history of onset, and it seemed

impossible to know at first whether the different animals seen and reported were all suffering from the same disease.

In brief, the methods pursued during this investigation were as follows:

1. Immediately upon the receipt of a report of a case in which investigation was desired, permission to make an autopsy was secured either by letter or telegram, whereupon representatives from both the veterinary and laboratory departments went to the infected locality taking with them a full laboratory field equipment.

2. As full a history as possible of the disease upon the affected farm and in the neighborhood was obtained. For this it was necessary to depend upon the memory of those interested with a resulting vagueness, which could not be avoided.

3. Careful observations concerning the environment, methods of feeding and housing stock, the water supply and other such general matters were made.

4. A thorough clinical examination was given the affected animals. This included not only physical examination, but laboratory study in the field in a large number of cases. Such methods did not, of course, yield as satisfactory results, as if continuous observations and daily records had been possible. The distance away from the laboratory, the necessity for immediately returning with the cultures and other materials collected, precluded day to day observations, and in only a few cases were the patients seen more than once. The department was not provided at first with any place in which sick animals could be kept, and although later the Laboratory of Animal Research permitted of the housing of such animals, it was only possible in one instance to secure a clinical case and have it brought to the laboratory where it could be under continuous observation. Unfortunately, this animal succumbed within six days after its arrival. This phase of the work had been planned, but before the completion of the building the disease had subsided and it was impossible to secure satisfactory cases. Relative to shipping of such cases, it may be mentioned that among those who are most familiar with the disease it is not believed to be infectious, nor has evidence to the contrary been obtained, and it would appear possible to ship animals safely from place to place if due care be taken.

From the rumors which had been heard concerning this disease and the early observations of this board, and investigations in Manitoba, attention was particularly directed to the blood. In the earlier cases therefore, where it was at all possible, microscopic ex-

aminations of the fresh blood were made and the counts of red and white cells recorded throughout the investigation. Living blood was examined for several hours at a time for the presence of blood parasites with negative results. The hæmoglobin was estimated by the von Fleischl instrument in the first few cases, but abandoned owing to the fact that the bar of this instrument could not be matched with the blood, which was much yellower in tone. In the later work the Tallquist method was employed. Direct cover slip preparations of the blood, fixed in alcohol and ether, or by heat, were brought to the laboratory and stained with eosin and methylene blue, Gram and Bismarck brown, Nocht-Romanowsky and Jenner's stains. For blood counts, hæmoglobin estimations and blood smears, it was found almost impossible to secure specimens by making an ordinary skin puncture, and the usual proceeding was to collect the blood as it flowed through a large needle from the jugular vein. In the records of cases which follow this was the method employed, unless otherwise specified.

Blood cultures were also made from the living animal, and where the owner was doubtful about allowing the animal to be killed for autopsy such cultures were always taken, if possible. The method employed in collecting this blood was devised to avoid possible contamination from outside sources, such as the skin, air, etc., and at the same time to permit of getting sufficient blood, in case the bacteria in the circulation were few in number.

A flat flask of about 100 c. c. capacity was provided with a rubber stopper having two perforations. Through one of the perforations, a glass tube passed nearly to the bottom of the flask and the projecting end was constricted in the flame, bent slightly, and to it had attached a rubber tube upon the other end of which was a large needle or trochar, contained in a test tube. The mouth of the test tube was plugged with cotton, which surrounded the rubber tube above the needle and prevented the entrance of micro-organisms. Through the other perforation in the rubber stopper, a short length of glass tube was inserted, so as to reach only a short distance below the stopper. Upon the free end, which was two or three inches long, a small bulb was blown and this was filled with cotton. Below the bulb the glass tube was constricted and bent in the flame. Into this flask about 70 to 80 c. c. of fresh peptonized beef broth was placed and the whole apparatus, including the needle enclosed in the test tube and with the rubber tube in position, was sterilized in the autoclave. The rubber stopper was

secured in place after autoclaving, by a sealing wax for glass. The broth in the flask was found to remain sterile indefinitely. These flasks were carried in such a way as to always remain in a vertical position.

In the field, the neck of the animal whose blood was to be examined, was shaven with knife or razor, thoroughly scrubbed with soap and water, followed by alcohol and corrosive sublimate. By means of a knife which had been sterilized immediately before in the flame, a small cut was made in the shaved sterilized skin over the jugular vein. The needle which was attached to the flask by means of the rubber tube was withdrawn from its test tube and thrust through the cut in the skin into the jugular vein. The air in the flask was exhausted by sucking upon the short glass tube which had been plugged with cotton, whereupon the blood flowed directly from the vein into the flask, and by gently shaking was thoroughly mixed with the broth therein contained. This diluted the blood and reduced to some extent its bactericidal powers, ordinarily increased during coagulation. After the withdrawal of about 10 to 20 c. c. of blood,* the rubber tube connecting the needle and flask was pinched with the fingers, and the end which fitted over the butt of the needle removed. Reversing the process by which the blood had been withdrawn from the vein and blowing through the short plugged glass tube, the blood which remained in the rubber tube and in the glass tube leading to the bottom of the flask, was expelled. When the mixed broth and blood appeared in this tube at the constricted bent portion above the rubber stopper, heat was applied from a blast lamp, and the tube hermetically sealed. At the constricted portion of the other tube, i. e., below the bulb containing the cotton stopper, the glass was also hermetically sealed in the flame. The use of a rubber tube between the needle and the glass tube, as also the use of a small piece of rubber tube attached to the mouth piece, avoided the danger of accident, due to movement of the horse, and the method was employed throughout the investigation with great satisfaction.

The sealed flask was brought to the laboratory for incubation and examination. Sub-cultures were made from it, where micro-organisms were found to develop.

Where swellings were found, such as upon the breast, neck or in the joints, either by means of one of these blood culture flasks, or a sterile glass pipette, fluid was collected in an aseptic way, mixed

*Care should be taken to see that the mixture does not contain too much blood, as some micro-organisms are masked in the clot.

with a large quantity of broth and brought to the laboratory and examined for micro-organisms. In one or two instances, also urine was collected during urination in a sterile receptacle, and mixed with large quantities of broth and incubated. The urine was also examined more than once, chemically. The delay in transit rendered the examination of less value.

5. *Autopsies.*—Where the animals had died before the arrival of the representatives of this board, unless putrefaction was already advanced, an autopsy was held. In most instances, however, as already stated, the animals were killed, either by bleeding or shooting in the head, and the autopsy immediately performed. Careful observations were made for the presence of swellings, subcutaneous hemorrhages and those situated between the muscles and fascia, and on the serous surfaces. Notes were taken of all gross findings. Materials were collected for examination from all tissues which showed microscopic change and were preserved, as a routine, in the three fixatives, 10 per cent formalin, 96 per cent alcohol and Zenker's fluid. In addition, as a routine, specimens of the various viscera were always taken. Blood smears and smears from the fluids found in the different cavities, and pus and other pathological exudates were made, as well as of the various organs of which small specimens were fixed, as already noted. The making of direct smears required care to prevent the deposit of dust, and they had also to be protected against flies, during the summer months. Where it had been impossible to collect urine or blood during life, these materials were collected at autopsy, so as to permit of microscopic, cultural and chemical examinations.

After the first few examinations, when it had been found possible to demonstrate micro-organisms in all the cases, less attention was paid to the search for blood parasites and every care taken to investigate thoroughly the possibility of bacterial infection.

Cultures were taken as a rule in the following way, and it frequently became necessary, in order to secure a satisfactory culture, to sacrifice the gross or microscopic specimens during the burning of the exterior.

(a) Cultures were made from the contents of abscesses, or from œdematous or hemorrhagic areas, as they were found subcutaneously between the muscles, or in the lymphatics. The procedure was to thoroughly burn the exposed surface by means of a gasoline blast lamp. The material, if fluid, was collected by means of a sterile pipette, into the mouth piece of which cotton had been inserted before it was sterilized, the other small free end having been

sealed in the flame. The sealed end was broken off, the slender tube, sterilized by heat with the blast lamp, was thrust through the burnt outer surface of an abscess, or other collection of fluid, and the material drawn into the pipette in considerable quantity, whereupon a few drops, sometimes as much as 5 c. c., were blown into tubes containing nutrient broth, and upon the surface of agar and. serum. Throughout these investigations, dependence was placed upon the use of broth cultures, it being found possible to carry tubes of broth in an upright position without serious inconvenience.

In the case of œdematous tissues or solid materials, very frequently a small portion was cut off with sterilized scissors, after the surface had been flamed thoroughly, and the piece dropped directly into broth. Smears for microscopic examination were made at the same time. In a few cases where the blood pipettes were not at the moment available, swabs were used for collecting the material from œdematous areas or abscesses. After thoroughly flaming the surface, and incising it by means of a hot knife, a sterile swab was thrust into the interior and thoroughly impregnated with the fluids. It was then immediately shaken out into tubes of broth and then used for wiping over the surface of agar and serum tubes.

(b) Cultures from joints were made in a similar manner to those described above.

(c) In case of the pleural, pericardial and peritoneal cavities, before opening, the outer surface was thoroughly seared, and by means of a pipette the fluid was withdrawn and a fairly large quantity, i. e., from 1 to 5 c. c. blown into 5 to 10 c c. of broth, and a few drops upon the surface of agar and serum tubes. Urine was collected on more than one occasion by the same process.

(d) Blood cultures were always made at autopsy, even though they had been collected before the death of the animal. A pipette was used for this purpose, and after searing the epicardium the pipette was thrust either through the heart wall into the cavity, or where the large vessels had already been cut, and danger of contamination was feared, a branch of the coronary vein was selected and several c. c. of blood was drawn up into the pipette, and from 1 to 5 c. c. blown out into 5 to 10 c. c. of broth. It should be mentioned that pipettes were used for collecting blood, pus, joint fluid, urine, bile or other such fluids. After the broth, serum and agar cultures were made, both ends of the pipette were fused in the blast lamp, and it was brought with the cultures to the laboratory.

(e) In the case of the lungs, liver, spleen, kidneys, heart wall, spinal cord, etc., either before the removal of the organs, or immedi-

ately after their removal, the outside was thoroughly seared and a puncture made by a knife which had been immediately before thoroughly flamed. By means of a swab, broth, serum and agar cultures were inoculated, and cover glass smears were made from the cut edges of the specimens removed for microscopic examination before they were put into fixative.

From the foregoing, it is apparent that a fairly well equipped traveling laboratory was carried in all cases, and it was necessary to select with some care the site at which the autopsy was to be performed, as shelter from the wind was necessary to some degree, and it was very desirable that the animal be buried at the spot where the autopsy was held. This point was kept in mind as much as possible, in order to impress upon the owners the necessity for the protection of well animals upon the place. Some attempt at photographing affected animals, and barns, and surroundings in infected districts was made, but without a great deal of success.

6. Upon returning to the laboratory, the notes made in the field were immediately gone into, a full description of the clinical aspects and what was found at autopsy and everything which had been done was placed upon record. Materials which had been gathered were subjected to a routine examination, as follows:

(a) All the cultures made during life, or at autopsy were placed in the incubator for 24 hours, and then examined, to see if growth had take place. If no change could be observed they were placed in the incubator for some further time and again examined macroscopically and microscopically.

In the case of cultures made from fluids, such as blood, although no growth seemed to develop for several days, on more than one occasion it was found that later growth could be observed where all possibility of contamination could be eliminated. This serves to show the bactericidal properties of blood and body fluids.

(b) In all cases the original cultures were examined for purity, and by streaking out, plating and other methods, the various bacteria were isolated. On many occasions, by going back to the original cultures, the presence of an organism which had escaped attention in the isolation work was found. If it had not been for this method, it is likely that in certain of the examinations, notably Cases 9-10-11, *B. equisepticus* would have been overlooked, owing to the fact that *B. pyrogenes equinus* was very abundant.

(c) In the identification of bacteria, their morphology, methods of staining, motility and spore formation were all carefully noted; their cultural characteristics in the common media, such as broth,

agar, serum, gelatine, Dunham's peptone solution and potato were observed. Gas and acid formation with the sugars, dextrose, maltose, lactose and saccharose were tested. The presence of indol was looked for and the results recorded, as also the action upon milk and litmus milk. In determining the pathogenesis, various laboratory animals were used, but information concerning this will be found under "Pathogenesis" in a description of the micro-organisms, *B. equisepticus* and *B. pyrogenes equinus*, and under "Experimental Investigations."

(d) In order to determine the relationship of the various bacteria found, to this disease, various animals, including horses, swine, dogs, rabbits, guinea pigs, pigeons, etc., were used for inoculation.

Attempts were made to extract toxines, and full notes, including daily or hourly observations upon the symptoms, and in the case of horses, blood counts, temperatures, etc., etc., were recorded. A fuller description of this will be found under "Experimental Investigations."

DETAILED REPORT OF EXAMINATION OF CASES OF "SWAMP FEVER."

The following is a detailed report of the examination of cases of "Swamp Fever":

Outbreaks I. and II.

Cases 1–5, 9, 10, 18, *Beltrami, Polk Co.*—Nov. 2, 1901, Drs. Brimhall and Wilson visited Beltrami, Minn., on a report of the presence of swamp fever received through the local town chairman, Mr. Gullickson, and made inquiries concerning and collected specimen from five supposed cases of the disease. The disease has been prevalent in the neighborhood for several years and a small outbreak usually occurs each spring, from April to May, followed by a partial or complete cessation of the disease during June and July and then a second and larger outbreak begins in August, and extends throughout September and October until cold weather intervenes. The country in the vicinity is in the midst of the Red River Valley, i. e. old Lake Agassiz basin, and is consequently quite flat. The Sand River flows near the town, and both spring and fall frequently overflows its banks. It sinks into a marsh west of Beltrami. Many of the cases were said to have occurred in horses which were in low pasture on land which had recently been overflowed by the river. This, however, was not true in all cases, one man, Mr M., having lost a number of horses last fall with the disease, and none of them had been on low pasture, i. e., on ground overflowed by the river.

Mr S. had three horses sick at the time of this examination, yet on his farm was no low ground, and two of the horses had not been running in pasture of any kind for several months before they became sick. Mr. O.'s mare, which was sick at the time of this examination had not been in pasture for several months, though a branch of the river ran through Mr. O.'s farm. Animals of all ages were affected. Previous good health or good condition seems not to be a factor in determining outbreaks.

The first symptoms noticed are usually moping or "dumpishness" on the part of the animals. They begin to be weak, particularly in the hind legs, rapidly lose flesh though consuming large quantities of food, since in most cases the appetite is retained until the very last. Some of the animals become mere skeletons in two weeks after the onset of symptoms; in others, the disease is much slower, running four to six weeks or as many months before the animal finally goes down. In some cases recovery occurs before the animal becomes so weak as to need help in getting up. When once the animal is down as a rule it dies within a week or two. The membranes appear to be very pale, and the blood is reported to be very light colored or almost absent entirely.

Direct coverslip preparations were obtained from five animals. *Case* 1—Mr. O.'s mare sick two and a half days. *Case* 2—Mr. S.'s colt sick one month and barely able to stand when specimen was taken. *Case* 3—Mr. S.'s colt sick one month, but not so ill as (2). *Case* 4—Mr. S.'s black mare sick two weeks, not very ill and apparently recovering. *Case* 5—Mr. S.'s brown mare sick only a few days. No symptoms except "dumpishness." May not have the disease.

Five coverslip preparations were taken from each animal. These were fixed in the flame and two from each animal stained with eosin and methylene blue. No bacteria were found present on any of the coverslips except in one of the two of Mr. S.'s colts (3). This had apparently not been sufficiently fixed in the flame and bacteria may have multiplied on it.

Direct coverslip preparations from each animal were also stained with Nocht's modification of Romanowski's eosin-methylene blue stain for malarial organisms. No foreign organisms were found in the bodies of any of the red cells. The leucocytes appeared to be very much increased in number in proportion to the red cells, though they were not counted. The coarsely granular oxyphile cells were especially numerous in the specimens from Case

Horse barn of Mr. Wm. S——, one mile north of Beltrami. Behind the barn the yard was rather low and boggy, but Mr. S—— was constructing a drain and filling, so as to obviate this difficulty. The house is in front and to the left on a raised sandy knoll. A flowing well near the point from which the photograph was taken gives rise to a small creek which keeps the surrounding black loam in a rather boggy condition owing to the flatness of the land. (Outbreak II.)

4. It may be noted that this animal had on her chest, at the time the specimen was taken, a large "bunch," evidently an abscess containing pus.

Nov. 16, 1901, Drs. Brimhall and Wilson again visited the farm of Mr. S., one mile north of Beltrami, Minn., to inspect Case 2. The farm is flat, covered for the most part with the rich black loam of the Red River Valley, but on the southwest corner in the direction of the Sand river is a gravel and sand ridge. The water is obtained from a flowing well between the barns and the dwelling house. Everything about the farm showed signs of careful supervision and prosperity. The horse stable was floored, and, although both horse and cow barns were situated on relatively low ground, provision was being made for raising and draining the barnyard. Some idea of the character of the stabling accommodations may be obtained from the cut No. 1.

The colt noted above as Case 2 had been sick about six weeks, and had grown gradually worse since the previous visit, November 2d. When seen November 16th he was down and unable to rise. The animal was killed by shooting and a complete autopsy made.

On removing the skin a few small petechial, hemorrhagic areas were found about the shoulder and groin. The right hind hock was considerably enlarged, the synovial membrane being puffy and filled with a cloudy, straw-colored serum. The cephalic lobes of both lungs were red, solid, airless and contained numerous pus cavities from one-quarter to three inches in diameter. About the middle of the dorsal border of the left lung was an abscess which bound down the pleura to the tissue ventral to the spinal column, involved the said tissue over an area of two or three inches and extended between the lateral process of the vertebræ into the spinal canal. The dura of the cord was apparently not involved. A few small hemorrhagic areas were scattered over the surface of the heart, particularly over the auricles. The liver was apparently normal except somewhat congested. The spleen was enlarged, pale and firm. The kidneys were a trifle pale, but otherwise apparently normal. The bladder was empty.

Direct coverslip preparations, broth and serum cultures and portions of tissue in preservatives were collected from the liver, lung, hock, spleen, anterior mediastinal gland, abscess of lung, dorsal abscess and blood from the carotid artery.

Direct coverslip preparations from the various sources noted above were stained with eosin and methylene blue, and on ex-

amination showed the following bacteria: From the carotid artery, lung, lung abscess, liver, joint fluid (hock), and anterior mediastinal gland, small diplococcoid bacilli. Preparations from the pus from dorsal abscess showed small somewhat slender bacilli, not belted but irregularly staining. Preparations from the spleen showed no bacteria.

Original Broth Cultures.—From the carotid artery blood, liver and spleen showed no growth. From lung, hock fluid, anterior mediastinal gland, lung abscess and dorsal abscess showed small diplococcoid bacilli, belted. In addition the cultures from the mediastinal gland showed chains of cocci in pairs. That from the dorsal abscess showed slender bacilli sometimes in pairs and occasionally in longer chains.

Original Serum Cultures.—No growth occurred on the serum cultures from the spleen. Serum cultures from the dorsal abscess developed only colon-like bacilli. From all of the other sources mentioned above cultures showed the small diplococcoid bacilli noted above. In addition, one colony of white staphylococcus was found on one serum culture from the anterior mediastinal gland.

Single colonies were picked from serum cultures from the various sources, except spleen and dorsal abscess, and grown on serum and then in broth. As a result, from the lung, liver, hock, carotid blood and lung abscess, a small diplococcoid belted bacillus was isolated in purity. It proved to be non-motile, non-Gram staining and otherwise indistinguishable morphologically from *B. bovisepticus.* This strain of *B. equisepticus* (description page 342) was found virulent for rabbits when tested several months later.

Blood was collected from the carotid artery and mixed with Toisson's fluid, brought to the laboratory and the red count made. Red cells were 5,420,000 per c. c.

Nov. 16, 1901, Drs. Brimhall and Wilson examined and collected specimens of blood for cell counting from the animal noted in the first report as colt No. 3. This animal had been sick about two months, and was apparently on the road to recovery. Blood was collected for the red and white count and brought to the laboratory. Red blood count of blood collected November 16th was 4,839,000 per c. c. The white blood count was not made.

On July 24, 1902, Drs. Brimhall and Wesbrook arrived in Beltrami in response to telegrams sent by Mr. Wm. S. Mr S. had thirty horses and had lost ten within a period of a little over a year, with symptoms which would seem to indicate that for the

most part they died of the same disease. (In one animal a possible history of tetanus was obtained.) Mr. S. had lost three horses already this year, and several neighbors had also lost horses, or had them at that time sick with apparently the same disease so far as the histories could be obtained.

On July 24th two animals were found sick. One of these was killed, and will be referred to as Case No. 9. The second one, Case No. 10, was examined and specimens taken from it.

Case 9 was a brown filly with white face, rising two years old. She had been noticed ailing for three weeks, and was found lying down and unable to rise. She was greatly emaciated, but showed considerable œdema in the gluteal region, more particularly of the right hind leg. There was marked swelling extending from the left hock to hip, great pallor of the mucous membranes of the eye and mouth. Pulse, 80; temperature when first observed, 103½° F. Appetite very good. A suitable place for work was prepared on a spot where the animal could afterwards be buried. The animal was dragged on a stone boat to this place, and during the journey reached out and ate grass by the wayside. Examinations were made of the blood collected from the jugular vein during the forenoon, viz., for about four hours.

Blood coagulated very quickly, and when flowing from the artery was much lighter in color than usual. Hæmoglobin, 60 (Tallquist), 52 (von Fleischel), but even with yellow light the blood was much lighter than the bar, and could not be quite matched. A blood count was impossible, owing to an accident to the hæmocytometers. Microscopic examinations of fresh preparations showed cells which were of no greater diameter than one-fourth to one-fifth the size of the normal red cell. Others were seen which were twice the normal size. There was great variation also in shape. No bacteria were encountered, and nothing resembling any of the known hæmatozoa or filaria was found.

Culture.—By means of a sterile pipette about five c. c. of blood was collected from the jugular as it spurted in a large stream. This was placed in a flask containing 50 c. c. of sterile broth and was sealed in the flame of a blast lamp. The animal was bled to death by severing the right carotid artery and an autopsy held immediately.

Autopsy.—Absence of subcutaneous fat made skinning very difficult. As the skin was removed hemorrhages and a jelly-like œdema over right hip and around root of tail were seen. In the right gluteal region was a large abscess irregular in outline and

containing about six litres of curdy, light yellow pus. The abscess verged on the right hip joint, nearly involved the rectum, extended along the iliac vessels, causing a thrombus of the right iliac vein, and presented in the sacral region beneath the peritoneum, where it caused a bulging. Over this bulging the connective tissue was infiltrated with a clear, yellowish fluid, so that between the peritoneal surface and the abscess there was about one to one and a half inches of a jelly-like material.

The right hip joint showed inflammation and infiltration behind the capsule, especially on the aspect towards the abscess. Particles of fibrin and a small blood clot were present.

The left hind leg, which was very greatly swollen, showed on skinning, in the sciatic region especially, a clear, yellowish, gelatinous infiltration of the superficial connective tissue extending from the hock to the pelvis and surrounding the whole leg. On cutting into this, yellowish red flocculi, apparently hemorrhagic in character, were found extending along the inter-muscular septum parallel to the inner aspect of tibia.

In the left sciatic region a large abscess which held about 1,000 c. c. of a fluid, reddish yellow pus (probably hemorrhagic) was encountered. In this was found a rounded hemorrhagic mass which somewhat resembled a lymph gland one and one-half inches by one-half inch in size. The left hip joint showed hemorrhages around capsule, and was purulent within the capsule. The right hock was greatly swollen, and contained a large quantity of straw-colored fluid.

Abdomen.—The mesentery of both large and small intestines, and capsules of the right kidney and spleen, showed patches of hemorrhagic infiltration irregular in size. A chain of hemorrhagic lymph glands extended from ileum to right kidney. The spleen and liver seemed normal, but were somewhat bloodless. Kidneys were pale, swollen and showed parenchymatous nephritis.

Thorax.—The lungs were stippled on the surface with minute reddish spots. The apices were red, solid, somewhat depressed, and studded all over with abscesses varying in size from a pea to a marble. The apex of the right lung was involved over an area of about four by five inches, the left somewhat less. In the other portions of the lung were three or four hemorrhagic solid areas from about one-half to one inch in diameter. The pericardium contained a considerable quantity of a clear straw-colored fluid. No hemorrhages were seen. The heart was tightly contracted. The muscle was pale, and one of the leaflets of the mitral valve

was hemorrhagic and œdematous. The spinal cord was very white, and the gray substance did not stand out in marked contrast.

Specimens for histological examination were collected from (a) hemorrhagic area along intermuscular septum, left hind leg. (b) Rounded hemorrhagic area of lymph gland in abscess on left popliteal region. (c) Hemorrhagic lymph gland from small intestine. (d) Apex of right lung. (e) Spleen. (f) Liver. (g) Kidney. These were preserved in the usual way.

Cultures taken at autopsy gave the following results:

B. equisepticus (for description see page 342) was obtained from an œdematous area of the popliteal region and from the jugular blood. *B. pyrogenes equinus* (for description see page 346) was obtained from an œdematous area of the popliteal region, an œdematous area of the left thigh, jugular blood, the peritoneum, the peritoneal gland, the spleen, the liver and the kidney.

B. coli communis was obtained from an œdematous area of the popliteal region, an œdematous area of the left thigh, from an abscess of the right hip, an abscess of the sciatic region, the peritoneum, the peritoneal gland and the spleen.

A streptococcus was obtained from the joint fluid and abscess of the right hip. Staphylococci were found in the pleural cavity and in the liver. Unidentified bacilli were found in an œdematous area of the left thigh, the peritoneum, jugular blood, lung, peritoneal gland, liver and spinal cord.

Case 10.—Blue roan filly, two years six months old. Had been sick for two or three weeks on July 24th, when first seen by Drs. Brimhall and Wesbrook. Very greatly emaciated; showed pallor of mucous membranes and great weakness in hind legs. Temperature 102.5° when seen at 7 a. m. At 7 p. m. an area over the right jugular vein was shaven, sterilized with corrosive sublimate, and by means of a large freshly boiled hypodermic syringe about 3 to 5 c. c. of blood was withdrawn, and mixed with about 50 c. c. of sterile broth in a flask and hermetically sealed.

Hæmoglobin test (Tallquist), 50 to 60; (Fleischl), 55. Red blood cells, 2,668,000; leucocytes, 422,000. Brought to laboratory—delay of 18 hours.

Examination of the blood showed great poikilocytosis. Blood smears were dried and some fresh preparations made for examinations the next day in the laboratory, but they spoiled in transit.

August 1st the colt was again examined. It did not seem any weaker. The neck was shaven, and by means of a hypodermic needle and a rubber tube and glass bulb about 5 to 10 c. c. of blood was collected and mixed with 50 c. c. of broth. The flask broke, but as much of the material as could be saved was brought to the laboratory in four pipettes, from none of which was a growth obtained. No blood count made.

Aug. 19, 1902.—On this date Mr. S. had consented to the killing of the colt, which was very much weaker and thinner than when before seen. He stated that the colt was sick a year ago, but had regained its flesh and appeared to recover during the winter. At this date it had been sick about five weeks. Emaciation was extreme, though the appetite was good. Its attitude was that of dejection, and it appeared to move with difficulty. Mucous membranes were very pale; a small ulcer on the lower lip, quite comparable to those in Cases 14 and 15 (see pages 293 and 296), was found. Temperature 103° (before collecting blood culture); 102.5° (after collecting blood culture); pulse 90 (after collecting blood culture); respiration 38 (after collecting blood culture).

At first it was decided not to kill the horse but to bring him down for demonstration before the American Veterinary Medical Association at its meeting in Minneapolis. Therefore, blood cultures and blood for microscopic and other examinations were collected as follows:

(1) Blood culture in flask, see below.

(2) Blood coagulated in test tube for Widal reaction.

(3) Blood smears for staining.

Hæmoglobin test (Tallquist), 40.

Blood count. Red blood cells, 1,252,000; leucocytes, 12,000 (counted August 21st).

At about 6 o'clock the colt had fallen down in the stall and was unable to rise; the pulse and respiration had gone up very greatly with the struggles, and it was decided to kill it.

Autopsy.—(Drs. Brimhall and Wesbrook). At 6:30 p. m. August 19th. Extreme emaciation; no subcutaneous fat; possibly a few subcutaneous hemorrhages on the right side. This may have been due to dragging through the barn.

Joints showed no swelling, hemorrhage or pus, though from the left hip joint a great deal of fluid escaped. This showed some fibrin flocculi. In the adductor muscles of both hips were hemorrhagic areas. In the extensor muscle of the right hip was an abscess about three inches long and one-half inch in diameter and

"SWAMP FEVER" CASE NO. 10.

Colt, two and one-half years old, belonging to Mr. Wm. S——, who lives one mile north of Beltrami, Minn., and who has lost ten horses. This animal had been sick about seven weeks on the day the photograph was taken (Aug. 19, 1902). Later in the day the colt fell down, was unable to rise, and was therefore shot and an autopsy held. (See page 283.)

showing a well marked wall. Hemorrhages were present in the muscles surrounding it.

In the belly wall, between the peritoneum and the muscular coat in the neighborhood of the umbilicus, the tissues were infiltrated with pus in a flat layer, which did not communicate with the peritoneum nor open on the skin. There were hemorrhages in the same vicinity.

Thorax.—Anterior mediastinum showed masses of swollen and hemorrhagic lymph glands; pericardium filled with an amber colored fluid (about one litre).

Heart showed yellowish œdema in the auriculo-ventricular groove, following the coronary arteries. This was about two inches in width, and in the thickest portions was possibly one-half inch thick. The heart wall was anæmic, light colored, and may possibly show fatty degeneration on microscopic examination. Under the endocardium were a few small hemorrhagic areas in the left ventricle.

The pleura showed no exudate. Lungs pink throughout except for the presence of five or six small purplish, hemorrhagic areas along the lower border. There was no stippling; no pneumonia; no pus. In the cut surface some of the lobules seemed to be more or less solidified with hemorrhages, though, except for those mentioned, they did not show on the pleural surface.

Diaphragm, normal.

Abdomen.—Intense peritonitis, almost as marked as in Case 11 (see page 290). Flakes of fibrin covered all the viscera.

Coeliac axis occluded by organized thrombus surrounded by a dense mass of hard connective tissue two or three inches in diameter.

Hemorrhages of the peritoneal surface of caecum. Many small, round worms were found on the inner coat of the caecum. The lymph glands of the mesentery and those next the spleen and kidney were very greatly enlarged and hemorrhagic.

Liver very much enlarged, pale and showing an apparently acute parenchymatous hepatitis. The surface covered with flakes of fibrin adherent to the capsule.

Spleen somewhat enlarged. Covered with exudate in masses; firmer than normal and showing apparent increase of the interstitial tissue and thickness of capsule. No hemorrhages were apparent. At the apex of the spleen was an abscess, globular in shape and about two and one-half inches in diameter. This was

firmly walled off from the spleen and was adherent to the peritoneum near the left kidney. Here was a large area of hemorrhage.

Kidneys were swollen, pale and resembling those in acute parenchymatous nephritis. Capsules stripped easily. There was hemorrhage in the capsule of the left kidney, contiguous to the area in the peritoneum where the abscess of the spleen impinged. On section the cortex of the kidney was very greatly increased in thickness and paler than usual.

Bladder was empty, and on the peritoneal surface of the left side showed a hemorrhagic area about one and one-half by two and one-half inches.

Tissues for histological examination were collected from (1) spleen, (2) heart muscle, (3) anterior mediastinal lymph gland, (4) liver, (5) left kidney, (6) hemorrhagic area, lung margin, (7) hemorrhagic area, adductor muscle, left hip and (8) abscess wall, right hip. These were preserved in the usual fixatives.

Direct coverslip preparations were made from (1) jugular blood, (2) peritoneal fluid, (3) pericardial fluid, (4) left hip joint fluid, (5) spleen, (6) abscess of spleen, (7) abscess belly wall.

Cultures were made from (1) jugular blood, (2) heart's blood, (3) peritoneal fluid, (4) lung, (5) liver, (6) spleen, (7) left kidney, (8) hemorrhagic lymph gland, (9) right hip joint and (10) abscess of spleen.

The cultural findings were as follows:

B. equisepticus was found in an abscess of the spleen, hip joint, heart's blood, spleen and liver. *B. pyrogenes equinus* was found in an abscess of the spleen. Staphylococci were present in the hip joint fluid. A large, Gram-staining spore-bearing bacillus was present in the spleen abscess, heart's blood, jugular blood, lung, peritoneum, peritoneal gland, spleen, liver and kidney.

Case 18.—This case was first seen by Drs. Brimhall and Wesbrook Aug. 19, 1902. The animal was a black mare four years old, stated by Mr. S. to have been sick last year when she had an abscess between the front legs. There was still thickening in this region, although in other respects the animal seemed to have made a perfect recovery, and was fat and sleek. She had, however, a marked swinging gait in her hind legs, and Mr. S. hesitated about putting her to work for fear she would "go all to pieces." He had tried to work her this year, but she seemed unable to stand it, and he feared a relapse of the disease.

From this animal blood was collected by means of an aspirating needle in the test tube, allowed to clot and the serum used for

Widal reaction. Temperature, 100.6° F. Respiration, 18. Hæmoglobin, 90 (Tallquist).

Outbreak III.

Case 6, Mr. K., Red Lake Falls, Red Lake Co.—Nov. 18, 1901, Drs. Brimhall and Wilson examined and collected a specimen of blood for red and white count from a mare, the property of Mr. K., living six miles southwest of Red Lake Falls, Minn. This animal had been sick but one week, and was apparently quite ill, exhibiting symptoms which the owner declared were exactly parallel to those of an animal which died about 48 hours before on the place, of supposed "swamp fever." The body of the second animal was also opened, but was found to be in an advanced state of decomposition, so that no specimens were collected therefrom.

Red cells were 9,988,000 (?) per c. c.

Outbreak IV.

Case 7, Belgrade, Stearns Co.—Nov. 23, 1901, Drs. Brimhall and Wilson visited the farm of Mr. Q., three miles south of Belgrade, Minn., and made an autopsy on the body of a four-year-old horse which had died 24 hours before. The animal had been hauled out of the barn to the open prairie immediately after its death. The weather was cold, and when the body was opened decomposition was scarcely noticeable. On removing the skin of the upper side of the body a few small—about one-fourth inch in diameter—hemorrhagic areas were found subcutaneously and within the fascia. A few somewhat larger areas were found between the shoulder and ribs. The lungs were markedly emphysematous, and showed in the cephalic lobes some small areas of congestion almost, if not quite, hemorrhagic. The heart wall exhibited hemorrhagic areas beautifully marked, and from one-fourth inch to three inches in diameter. The heart itself was hypertrophied.

Direct coverslip preparations, broth and serum cultures and fluids and tissues were collected from the following sources: Pericardial fluid, anterior mediastinal gland, heart's blood, lung, spleen, liver and urine.

Direct coverslip preparations from the heart's blood, lung and anterior mediastinal gland showed numerous small diplococcoid belted bacilli, indistinguishable morphologically from *B. bovisepticus*. Those from the liver and spleen showed only large square ended bacili in chains (putrefactive ?). Those from the joint fluid showed no bacteria.

Original broth and serum cultures were placed in the incubator, supposed to be kept at a temperature of 37° C., but an intense overheating of the room during the night caused the temperature to reach 41° C. No growth occurred in or on any of the cultures. They were then removed from the incubator and let stand at room temperature. When examined again after 48 hours a fair growth had developed.

It is probable that this bacillus was *B. equisepticus*, although the studies were not carried further, and the cultures died out before pathogenesis and cultural characteristics could be determined.

Outbreak V.

Case 8, Wylie P. O., Red Lake Co.—Through Mr. O. R., Wylie, Minn., information had been received that Mr. E. A. H., living six miles southwest of Wylie, had "swamp fever" existing among his horses, and was willing to permit an autopsy and examination of one then suffering at that time with the disease.

On January 20th Drs. Brimhall and Wesbrook visited Mr. H.'s farm, killed the animal suffering with the disease, made autopsy and took specimens.

History.—Since 1895 Mr. H. has lost in all 15 animals with this disease, including the one killed on January 20th. These animals include those raised on his own place, as well as purchased animals. Mr. H.'s buildings, which are good, though unpretentious, are situated on the side of a gentle slope, the barn being within about 100 feet of a small piece of swamp. Next the barn is a pig stye. Within 20 feet of the barn and between it and the house and about 100 feet from the swamp is the well. On the top of the slope or on the other side of it, it is impossible to obtain water within easy walking distance, according to Mr. H.'s account. The stable was well arranged and reasonably clean with a dirt floor. It showed evidence of having been recently whitewashed, and Mr. H. gave an account of the steps taken for the renovation of the stable in his efforts to get rid of the disease. The bodies of the animals which had succumbed to the disease had been disposed of by burying. The feed used consisted of native hay cut on low lying land, for the most part on another quarter section, a mile southwest of Mr. Wylie's home. It was not the coarsest quality of swamp hay, but that cut from the edges of the swamp. There was no history of the use of musty or other unsuitable food, and oats were given in abundance.. All animal had been pastured

for variable lengths of time. Mr. H.'s method of looking after his stock was spoken of highly by his neighbors. No history of overwork or under feeding could be obtained. There seemed to be an impression in the neighborhood that all horses obtained or bred by Mr. H. were doomed to die of "swamp fever," and he had seriously contemplated the use of oxen. The disease was present on several neighboring farms, but no one had suffered to the same extent as Mr. H.

The disease as described by Mr. H. was chronic in nature; paroxysmal fever; increase of appetite; pallor of mucous membrane; loss of weight; weakness in hind legs and tumefaction of the subcutaneous tissues between the fore legs, extending in some instances back under the abdomen. Accent was laid upon the weakness of the hind legs and areas of profuse sweating, especially over the posterior half. Mr. H. also spoke of the great thirst and profuse diuresis.

Clinical Notes.—Bay mare, about 1,200 pounds weight, aged 10 years, bred by Mr. H.—There remained in the barn only one horse (half brother to this mare), which had been bred by Mr. H., resisting infection up to the present time. The mare had been sick since midsummer, 1901. Ate voraciously and drank greedily throughout disease; some loss of flesh; staring condition of the coat; evidences of sweating over the posterior half of the body; slight pallor of the conjunctival, buccal and lingual mucous membranes was observed. Temperature 101° F. Pulse 46. The weakness in the posterior limbs was very marked, and especially noticeable in turning, when the legs became crossed. In walking the toes of the hind feet were dragged. Some slight œdema was observed.

The animal was killed by a blow on the head at 1:30 p. m. January 20th, dying without a struggle.* Immediately after falling several quarts of yellowish colored urine were voided.

Autopsy.—Subcutaneous and inter-muscular hemorrhages and œdema.

In the subcutaneous tissue between the fore legs was a hemorrhagic area showing some œdema and traces of thickening and showing traces of old hemorrhages in the yellowish or brownish color. This was possibly the remains of a large swelling which

*The body of the animal was drawn on a stoneboat several hundred yards and Mr. H. was given specific instructions for its easy cremation. Directions were given that lime be sprinkled plentifully over the ground where the autopsy had been made.

Mr. H. said had been present some time before. Under the chest muscles was found a deeper hemorrhagic area.

In the groin was found an area showing some yellowish œdema and several lymph glands showing hemorrhagic lesions.

Joints and Bursæ.—The right hip joint was filled with a whitish seemingly purulent fluid, and showed some erosion on the acetabulum. There was some considerable fluid in the bursa of the left hock. The right shoulder joint showed considerable fluid containing a flaky precipitate. The anterior mediastinal lymph glands were hemorrhagic. The lungs showed a few small hemorrhagic areas irregularly distributed. The pleural cavity showed no excess of fluid.

Pericardium and Heart.—The pericardial sac contained about eight ounces of a sanguineous fluid. The heart showed numerous recent hemorrhagic areas scattered over both auricles and both ventricles, some of which infiltrated the muscular layer and presented under the endocardium. Over both ventricles were scattered areas of white scar tissue, irregular in outline, varying in size from a dime to a quarter. These seemed to penetrate into the muscle, and in some instances included the whole thickness of the heart wall. Some of the areas showed cicatricial depression. There were approximately ten to fifteen of these areas. The valves and aorta showed no lesions.

Diaphragm, stomach and intestines—normal. Spleen—normal in size and consistency, showing one hemorrhagic area. In close proximity to this was a slight depression looking like cicatricial retraction. Liver—enlarged, showing the marking very distinctly and seemingly bile-stained. The macroscopic appearance of the cut surface of the liver suggested at first a chronic venous congestion or "nutmeg" liver.

Kidneys showed some swelling (?), and possibly bile pigmentation, especially marked in the left kidney, which was very much enlarged. It showed a swollen cortex, and the markings were somewhat indistinct.

From the calyces was expressed a viscid, light yellowish fluid material with here and there minute colorings or streakings suggesting blood pigment. Sublumbar lymph glands, enlarged and hemorrhagic.

Bladder very greatly contracted; showed a hemorrhage in its external wall. From a cut at the urethral opening was expressed a semi-solid material of about the consistency and color of French

mustard, which had a tendency to solidify on cooling. On opening the bladder, on the mucous surface were found several small hemorrhagic areas which were not visible until this semi-solid material had been scraped from the surface. The bladder contained about eight or ten ounces of this material.

Direct coverslip preparations were collected from the jugular blood, pericardial fluid, heart wall, spleen, lung, anterior mediastinal lymph gland, kidney and spinal cord. These, when stained with eosin and methylene blue, showed small colon-like bacilli.

Cultures were made from the jugular vein, coronary vein, hemorrhagic lymph glands from anterior mediastinum, groin and above kidney, from pericardial fluid, hemorrhagic areas of lung, chest and groin, from spleen, pulp, liver, kidney, clot in right iliac vein and from urine.

The following micro-organisms were obtained:*

(A) A colon-like bacillus. Morphology; motile, somewhat thick bacillus; did not stain sharply with methylene blue. Spore formation not observed.

Agar; fine, discrete, somewhat translucent grayish colonies. Serum, amber color. Fine discrete colonies, becoming confluent. Sugars. Dextrose, much reddened; saccharose, slightly reddened; lactose and maltose, unaffected. Broth, slight universal turbidity; no pellicle.

(B) Possibly a saprophytic bacillus of the proteus type; no spores observed.

Morphology. A slender bacillus slightly longer than colon, with methylene blue looking almost glass-like. Motile.

Agar; from central streak, a growth suggesting feathers, abundant, whitish, dry. Serum, dry growth, slightly liquefying. Broth, universal turbidity; pellicle. No spores observed.

(C) A bacillus about the size of type C, *B. diphtheriæ.*

Morphology. Agar, abundant, whitish rounded colonies. Serum, rounded colonies, somewhat amber colored. Sugars, no effect. Broth, universal turbidity; feebly motile. Spores overlaid end of bacillus something like symptomatic anthrax.

(D) A bacillus; irregular shapes.

Morphology. Flask, racket and other irregular rounded shapes; polar staining. Granules, irregularly disposed. Vacuoles, irregu-

*Owing to the difficulties in technique dependent upon the absence of platinum needles and individual swabs (10 swabs in tube) together with the fact that the broth tubes had been paraffined, and in the intense cold (35° F. below zero) the paraffined plugs stuck, a large variety of bacteria was encountered.

lar lengths and widths. Bacilli, usually single. Agar, abundant, white growth; serum, rounded amber colonies. Sugars, dextrose, only slightly reddened. Broth, slight, universal cloudiness.

(E) Minute bacillus—suggests hemorrhagic septicæmia. Morphology; rounded, pale staining bacillus, suggests streptoccus; sometimes diplococci or belted form. Agar, faint growth, sometimes not visible; serum, no visible growth. Sugars, lactose, minute discrete colonies, no change in color; saccharose; minute colonies, perhaps slightly reddened. Dextrose, more abundant growth. Minute colonies; slight but distinct reddening. Broth, universal turbidity.

Summary.—Left kidney. Perhaps contained A. in nearly pure culture; possibly some D. to begin with.

Heart wall. Nothing but B. obtained.

Lung, hemorrhagic area and a white, dry, slimy-looking mould.

Pericardium. B. apparently pure.

Gland above kidney. Probably pure culture of C

Bursæ, left hock. B. mixed with a red mould.

Right shoulder. C. in purity.

Hemorrhagic lymph gland, anterior mediastinum. Apparently pure culture of E. Original culture shows a dry mould.

Deep hemorrhagic area of chest. B. apparently pure.

Superficial hemorrhagic area of chest. B.

Hemorrhagic lymph gland. C. apparently pure.

Œdematous area in groin. B. apparently pure.

Outbreak VI.

Cases 11, 12, 14, 15, 16, 17, *Beltrami, Polk Co.*—On Aug. 1, 1902, Drs. Brimhall and Wesbrook visited the "P——" farm, which is under the management of Mr. H. P., and is situated four miles south of Beltrami. The farm is low-lying, flat and covered with a thick, heavy loam and just at the barn, is somewhat wet. The floor of the barn is low, and until recently, was remarkably wet. The constantly flowing well makes it practically impossible to keep the barnyard and environments dry.

Mr. P. reported that one horse had died three weeks before. Dr. Douglas, V. S., had pronounced the case pneumonia. Two were found sick at the time of the visit of Drs. Brimhall and Wesbrook.

Case 11—*Clinical History.*—Horse—aged—bay, weight, in health, 1,500 pounds, 16 to 17 hands high. In this case there was a history of influenza, one year before, since which time there had been catarrhal discharge from the nose, and water escaped from the nose

on drinking. Breathing had been noisy. When seen on August 1st, he had been sick for one week. He had eaten and drunk well, to July 31st. As he stood in the stall he appeared to be very ill, his head hanging and his breathing noisy and very labored. He was much emaciated, and could be made to move only with difficulty. His mucous membranes were pale, and there was a foul smelling nasal discharge which (foul smell) had been present for three days. His temperature was 103°. Within an hour after he was first seen by B. and W., he walked 15 feet, fell down and was unable to rise. He was shot in the forehead at 9:30 a. m., August 1st, and an autopsy held upon him.

A blood count was made from blood collected from the small vein of the nose, on August 1st, 9 a. m. and examined August 2d, 4 p. m., red blood cells, 4,224,000—leucocytes 57,000—Hæmoglobin (von Fleischl) 50 to 60—(Tallquist) 70.

Autopsy.—On removing the skin, subcutaneous hæmorrhages were few and small. Fat was almost absent. There were no abscesses encountered in any of the limbs, and no large hemorrhagic or œdematous areas found, except a hemorrhagic exudate between the muscles of the right groin. The joints were not hemorrhagic, nor purulent, although the fluid appeared to be increased, particularly in the left hock. The chest contained only a small amount of fluid, which was neither fibrinous nor hemorrhagic. The lungs were dotted with minute purplish hemorrhagic areas. The surface of the lung over these areas was not covered with fibrinous exudate. In more than one place, particularly along the anterior portions, were emphysematous blebs in both lungs. These were dark in color and contained hemorrhage in small amounts, or were next to hemorrhagic portions of lungs. The pericardium contained considerable sero-sanguineous fluid. On the anterior aspect of the heart, in the auriculo-ventricular groove was a large area of yellowish jelly-like œdema, with hemorrhagic appearance of the borders. The heart itself was somewhat pale. The mediastinium contained one or two soft purulent glands; this was the only area where pus was met with in the horse. The pleural surface of the diaphragm was covered with some fibrinous exudate, and upon its surfaces were a number of slender white worms, about two or three inches in length. These were preserved for examination (*Filaria papillosa*).

The peritoneal sac contained a considerable quantity of yellowish fluid, in which were numbers of fibrinous threads. The peritoneum and the surfaces of nearly all the viscera were covered

with flakes of white lymph, or fibrin. On the liver particularly, they looked like the white crests of breaking waves. In the mesentery were numerous hemorrhages, and the lymph glands, both in the lumbar region and those attached directly to the left kidney, showed hemorrhages. Around the coeliac axis, which was occluded by an organized thrombus, was a large accumulation of connective tissue. The liver was large and dark, and covered with white flakes of lymph. The spleen was very much enlarged, covered with white flakes of lymph and contained large hemorrhages, some of them recent, and some of them apparently older. None looked to be older than a few days. The more recent looking areas resembled a purple jelly. The kidneys were large, somewhat pale, and suggested parenchymatous nephritis. The nervous system was not thoroughly examined, but in the cervical region the vertebral canal showed an area of hemorrhage and œdema external to, and present upon the dura. The interior of the spinal cord in the cervical region and the lumbar region gave no development of colonies when sown in the various media. Upon opening the nasal cavity, both nares were found to be filled with a very foul smelling accumulation of food.

Direct coverslip preparations, tissues for histological examination and material for cultures were collected from the usual sources.

The bacteriological findings were as follows:

B. equisepticus was found in the heart's blood. *B. pyrogenes equinus* was found in the joint fluid, heart's blood, pericardial fluid, lung, mediastinal gland, peritoneal gland, spleen, urine and spinal canal. *B. coli communis*, was found in the lung, liver, kidney and spinal canal. Unidentified bacilli were present in the heart's blood, pericardial fluid, lung, liver, kidney, urine and spinal canal. Staphylococci were present in the heart's blood.

Case 12.—A gray mare. This animal had been ailing for three weeks, when first seen by Drs. Brimhall and Wesbrook, Aug. 1, 1902, but seemed somewhat stronger than Horse No. 11. The mucous membranes were very pale. Blood showed hæmoglobin test of 60 (Tallquist), and gave a red count of 3,400,000 with 33,000 leucocytes. The temperature when taken was 102.5° F. By means of a specially prepared bulb hypodermic, about 5 c. c. of blood were withdrawn from the jugular vein after the area over the vein had been shaven, thoroughly washed, soaked with corrosive sublimate, and a small slit made in the skin, immediately over-lying the vein. The blood was placed immediately in a flask of broth and sealed in

the blow flame. One-half the blood was put in one flask, and one-half into another.

Upon the chest and belly was an elongated œdematous swelling, about one-half inch thick and seven inches long, by three inches wide. This extended antero-posterially in the medium line. The skin over this area was shaven, sublimated and punctured with a sterile knife. From the dripping red fluid, which resembled blood, but probably contained a large amount of œdematous fluid, two sterile bulbs were filled and from them two 5 c. c. broth tubes were inoculated with about 2 c. c. each of fluid.

One of them developed *B. pyrogenes equinus* in pure culture. The other remained sterile.

The jugular blood developed *B. pyrogenes equinus* and a proteus-like bacillus.

The horse died a week later without warning, i. e., he lay down during the night and was dead at noon the next day. No word could be sent, and there was therefore no opportunity for autopsy.

Aug. 19, 1902, Drs. Brimhall and Wesbrook visited Mr. P.'s farm in response to a telegram from Mr. P., who reported that horse No. 12, had died a week after the above mentioned visit, and that he had two other sick horses which he wished examined, with a view of possibly curing them. He did not wish either one of them to be killed until he had consulted the owner.

Case 14.—This was a bay horse, 16 hands high, age 10 years. This animal had been sick about four or five days and had lost a good deal of flesh; coat was rather lusterless; temperature 102.2°; pulse 60; breathing rapid (26) and heavy; mucous membranes, pale, and one small ulcer on mucous membrane of lower lip; appetite was good, horse eating voraciously; left front leg swollen on knee and cannon. The horse seemed stiff and it was difficult to make him move. Profuse urination was noticed by Mr. P., and also by the writers. (Urinated five times in two hours.)

Jugular Blood.—Hæmoglobin, 70 (Tallquist). Red blood cells, 2,484,000; leucocytes, 9,000 (counted on August 20th). Blood was collected for the Widal reaction on aluminum foil, and blood was also aspirated from the jugular into a tube, allowed to clot and the serum collected in a pipette, for Widal reaction. (For this Widal reaction, see under "Symptoms.") Blood smears from the jugular were collected for staining; blood from the jugular was collected by means of an aspiration needle and drawn directly into a flask of broth, i. e., 5 c. c. in 50 c. c. broth.

By means of a swab, a broth culture was inoculated from the urine as it was passed naturally.

Aug. 26, 1902.—At 9 a. m. found by Drs. Brimhall and Wesbrook in the pasture unable to rise; ate as he lay; emaciation great. Ulcers on mucous membrane of lower lip five in number and increased in size over those observed on the 19th. Hemorrhagic areas on *membrana nictitans.*

Temperature 98.8. Pulse 48. Respiration 22.

Advised that the animal be killed, but Mr. P. was away from home. Photographs were taken as he lay in the field. A small artery on his nose was cut and specimens prepared as follows:

Smears for microscopic examination.

Blood for Widal in tubes open at both ends. Haemoglobin 60 (Tallquist). Blood for counting—red blood cells, 4,224,000, leucocytes 18,000; counted August 28th. At 5 p. m., Mr. P. having returned, he was killed by shooting and an autopsy made.

Autopsy.—Emaciation very great; absence of subcutaneous fat; yellowish tinge to fat-bearing connective tissue; marked areas of œdema and some hemorrhage in left groin; yellowish gelatinous œdema in left shoulder; hemorrhagic abscess outside left stifle joint; veins in sheath contained thrombi throughout.

Thorax.—Pericardium contained a large quantity of fluid, amber colored.

Heart showed a large area of yellowish, jelly-like œdema in the aurico-ventricular groove with tendency to hemorrhages at the margin. Heart muscle anæmic; ventricles showed thick walls very tightly contracted containing no fluid.

Lungs showed areas dark and semi-solid, particularly along the inferior border; flaky pleurisy; no large accumulation of fluid and hemorrhagic areas were not marked.

Diaphragm showed on the peritoneal border a very great number of small hemorrhages about one-eighth to one-fourth inch in diameter.

Peritoneal Cavity.—Marked peritonitis and flakes of lymph over the surface of the viscera. The fluid was somewhat gelatinous and amber in color and did not show many flocculi. Long white worms about three inches in length and one-sixteenth to one-thirty-second of an inch in diameter were met with in the peritoneum, and preserved in formalin. In the interior of the caecum were minute, white worms about one-fourth inch long, and also larger dark worms. These were preserved in formalin also.

"SWAMP FEVER" CASE 14.

This bay horse, aged ten years, belonged to Mr. Wm. P——, who lived four miles south of Beltrami. The animal had been observed to be sick for four or five days when the photograph was taken, on Aug. 19, 1902. On Aug. 24, 1902, one week later, being down and unable to rise, he was shot, and autopsy held. (See page 293.)

Liver swollen, dark color. Flakes of lymph covered the peritoneal surface of the organ. Many branches of the portal vein showed white thrombi.

Spleen showed some coating with fibrin. The color was pale and except for a very few minute dark areas there were no macroscopic changes.

Kidneys swollen, œdematous. Capsule stripped too easily. The markings (collecting tubules) were very distinct, though the color and friability suggested parenchymatous nephritis.

Bladder greatly distended with urine, and from it a sample was secured for chemical analysis by expressing the urine through the urethra. The peritoneal surface of the large colon showed a large hemorrhagic area about two inches or more in diameter. Under the mucous surface of the floating colon were small circular hemorrhagic areas about one-fourth of an inch in diameter.

Between peritoneum and transversalis muscle in the umbilical region was a well marked hemorrhagic area one and one-half by two and one-third inches.

The horse had suffered some years before with "*poll evil*," and the ligamentum nuchæ was found infiltrated with old curdy pus and lime salts for a distance of three or four inches from its insertion into the occiput.

Special Note.—The pus over the left stifle joint in this horse was very curdy and hard, and as abscesses had been observed in various horses, the suggestion occurred that probably the œdematous areas such as those present on the same date (August 26th) in horse 15 might later become purulent, and the composition of the area vary with the age of the lesion.

Direct coverslip preparations were collected from (1) fluid of left shoulder joint, (2) abscess over left stifle joint and (3) spleen.

Tissues for histological examination were collected from (1) ulcer of mucous membrane lip, (2) hemorrhagic diaphragm, (3) clot from sheath vein, (4) liver, (5) spleen and (6) semi-solid reddish area of lung.

Cultures were made from (1) left shoulder joint, (2) abscess left stifle joint, (3) pericardium, (4) lung, (5) blood from coronary artery, (6) liver, (7) spleen, (8) left kidney, (9) urine and (10) lumbar region, spinal cord.

The results of the examination of the cultures were as follows:

B. equisepticus was isolated from an abscess of the stifle joint, from the joint fluid, from heart's blood, from pericardial fluid, from the lung, spleen, liver and kidney. *B. pyrogenes equinus* was present

in the abscess of the stifle joint, lung, kidney and urine. Unidentified bacilli were present in the jugular blood, spleen and liver. Staphylococci were present in the kidney.

Case 15.—This case was seen first by Drs. Brimhall and Wesbrook, Aug. 19, 1902. The animal was a bay mare, 14 hands high, 5 years old, stocky build. Had been sick five to six days; refused to eat; first sign noticed, though appetite was good at the time of visit. Had lost some flesh, though still in fair condition; coat in good condition; sleek.

Temperature, 102°; pulse, 66; respiration, 17.

Mucous membranes not very pale; small ulcer on mucous membrane lower lip, about center, and one on tongue, lower aspect to left, and about one inch back of fraenum. Both hind legs swollen from hock down; much greater in right leg, which was also somewhat tender. Was reported to urinate more frequently than usual, though this was not observed by the writers. Hæmoglobin, 80 (Tallquist). Red blood cells, 7,264,000; leucocytes, 4,000 (counted August 20th).

Blood for Widal reaction on aluminum foil. (See page 337.)

Blood smears from jugular, for staining.

Cultures from right hock by means of aspirating needle into blood, then about 5 c. c. of the bloody fluid into 5 c. c. broth. No growth developed on incubation.

Aug. 26, 1902, the case was seen again by Drs. Brimhall and Wesbrook. Horse seemed pretty brisk, eating well and walking around in the pasture. Mr. P. stated that this horse and Case 14 remained together; docility and friendliness exhibited by desire to follow the observers around the field. Anæmia not much more marked; hemorrhage in mucous membrane of eye and on *membrana nictitans*.

Temperature, 104.2°; pulse, 64; respiration, 20.

It appeared that the marked activity, alternating with drowsiness at times, might be accounted for by the fever present. The swelling and lameness noted on August 19th, were gone. However, there was a swelling about size of small hen's egg in the neck on the right side, near the angle of the jaw. Also a large area of œdema over cartilages of prolongation on left side. This was tender. No fluctuation.

At 5 p. m. the following specimens were collected from jugular blood.

Blood for counting, not taken—no pipette.

Blood smears for microscopic examinations showed a bacillus resembling that of hemorrhagic septicæmia.

"SWAMP FEVER" CASE NO. 15.

Bay mare fourteen hands high, five years old, belonging to Mr. Wm. P——. Had been sick for twelve days when photograph was made on August 26, 1902. Had lost a great deal in weight at this time. The emaciation progressed and later abscesses developed. On September 7, 1902, i. e., twelve days later, her owner, believing that she would not live for another week, permitted her to be shot and autopsy held. (See page 296.)

Hæmoglobin, 70 (Tallquist).

Blood for Widal reaction on aluminum foil.

Blood culture from jugular, into flask of broth; this was shaken up, and after expelling the fluid in the tube and breaking off the glass in the flame, a small amount of the mixed blood and broth was blown into a test tube, i. e., about 5 c. c. of the mixed blood and broth to the 5 c. c. of broth in the test tube. This after incubation and sowing out showed *B. equisepticus*.

By means of a flask and an aspirating needle, the swelling under the jaw, on right side was aspirated, and about 5 c. c. of a sero-purulent fluid (amber colored) was mixed with about 50 c. c. of broth in the flask. The skin over the abscess was previously shaven and sterilized with sublimate. From this flask about 1 c. c. of the mixture of broth and the fluid from the swelling was expelled into a 5 c. c. broth tube, and serum and agar cultures were made directly from the fluid itself, as it dropped from the end of the aspirating needle. Cultures from these sources showed *B. equisepticus*, which killed rabbits in less than 16 hours after intravenous inoculation of 1.5 c. c. of a 24-hour broth culture. *B. pyrogenes equinus*, was also present. Not tested for pathogenesis. *Diplococcus pneumoniæ* (?) culturally typical, was also found. Direct coverslips of this fluid made in the field, showed all three organisms in apparently the following order of frequency; (1) *B. pyrogenes equinus*; (2) *B. equisepticus*; (3) *Diplococcus pneumoniæ*.

Sept. 7, 1902, the case was seen again by Drs. Brimhall and Wesbrook, who were accompanied by Dr. Torrance of Winnipeg.

The animal was thinner and had lost flesh rapidly since time of last observation, August 26th. Though still eating well, she was weaker. The swelling noted on the neck near the angle of the right jaw at the time of last visit had opened of itself, and was discharging pus. The large œdematous area seen at the time of last visit in the left hypochondriac region, now showed fluctuation, but was not tender, as before. The ulcer on the lower lip had increased in size, was about one-half inch in diameter, and showed an indurated base with depressed center and a brownish, horny surface. The pallor of the mucous membranes was slight, i. e., about the same as before; showed a yellowish tint. No hemorrhagic areas were seen on the mucous surfaces, nor on the *membrana nictitans*. Cornea of the right eye cloudy at margin. An area of œdema was observed in the right front leg, between the knee and fetlock. Gait, slightly "wobbling;" characteristic, according to Dr. Torrance. Temperature, 104; pulse, 68; slight anæmic thrill; respiration, 40.

Owner stated that he thought she might probably live another week.

At 2 p. m., Sept. 7, 1902, she was killed by shooting in the head. Immediately the jugular vein and carotid artery were exposed and incised, and specimens collected for blood count. (The Toisson's solution used had deteriorated, and a count was found to be impossible on arriving at the laboratory.)

Hæmoglobin, 60 (Tallquist).

As the blood flowed it separated so that small masses of red appeared in the clear spaces. This had been noticed many times before by Drs. Brimhall and Wesbrook, and was looked upon as somewhat chacteristic of the disease by Dr. Torrance. The blood from the jugular, was very dark colored, and that from the carotid was of a light cherry color. Blood smears were obtained from the jugular for examination.

The skin was removed from the left side exposing swelling on the cartilages of the ribs. It was covered and surrounded by an œdematus area in which was one hemorrhagic spot about one inch in diameter. After burning over the swelling an incision was made with a sterile knife, and a broth culture inoculated from the freely escaping pus by means of a platinum needle. This abscess was about seven inches long, four inches wide and one and one-half inches thick in the center. It was found later to present in the peritoneum. An abscess was present also in the neck on the right side near the angle of the jaw. This opened on the surface and has been mentioned in the clinical notes. The abscess was sharply circumscribed and lobulated. The main cavity was rough; small blood masses in its walls; the surrounding tissues showed many petechiæ.

Emaciation was not so great in this horse as in some of the others; the cut muscles were much darker in color than had been encountered in previous experiences. Two hard, somewhat flattened rounded objects, somewhat bean-like, were removed from over the left hip. They were enclosed in a bursa-like cavity in which they were freely movable and were respectively about one-half inch and one inch long. These were preserved in formalin.

Thorax.—The contents of the anterior mediastinum seemed normal. The pleural cavity contained no marked amount of fluid, nor was any pleurisy observable.

Lungs were of a pink color and showed a few hemorrhagic areas with gelatinous infiltration. There were a few small spots of a dark purple color. Pericardium contained about 500 c. c. of a clear straw colored fluid.

Heart (weight 10½ lbs.), showed an area of yellowish, gelatinous tissue in the neighborhood of the auriculo-ventricular groove on the lower border.

Abdomen.—Some fluid containing flakes of fibrin was met with, and a flocculent coating was seen on the surface of the viscera.

Diaphragm seemed normal.

Liver (weight 19 lbs.), surface slightly coated with whitish flocculi. The organ was dark in color and showed in one area a whitish infiltration which looked somewhat neoplastic. This was irregular in shape and about three-quarters inch in diameter.

Spleen, (weight 4½ lbs.), appeared normal in color, except for small petechiæ on surface.

Kidneys. Right kidney (weight 3 lbs.); left kidney (weight 3½ lbs.). Macroscopically these kidneys appear to show parenchymatous nephritis. The capsules stripped too easily. The cut surface showed a very beefy red medullary portion, whilst the cortex appeared cloudy and swollen.

Intestines appeared normal except for the presence of some hemorrhagic areas in the large colon. Contents of stomach and intestines apparently normal. Parasites noted, *filaria papillosa*, *strongylus letracanthus* and *ascarides*, not in unusual number.

The bladder had been nearly emptied during the death struggle. The residual urine looked like yellow paint. A sample of this was brought to the laboratory and showed on chemical examination, two days later, the following:

Chemical analysis (H. C. Carel)—

Sp. Gr.	1028
Reaction	Slightly alkaline.
Albumen	Trace.
Sugar	Absent.
Urea	2 per cent.
Earthy phosphates	Normal.
Alkaline phosphates	Heavy.
Chlorides	Heavy.
Sulphates	Heavy.
Hippuric acid	0.26 per cent.

Heavy sediment consisted of calcium carbonate with a little oxalate.

Microscopic examinations made on Wednesday, Sept. 10, by Dr. E. H. Beckman, showed:

1. Oxalate urea....................Very large amounts.
2. Uric acid........................Very large amounts.
3. Creatin ....Very large amounts.
4. Calcium oxalate................Very large amounts.

Direct coverslip preparations were collected from (1) jugular blood, (2) pericardial fluid, (3) pleural surface left lung, (4) peritoneal fluid, (5) spleen, (6) right hock, (7) abscess on left flank over cartilages connecting ribs. All of these, excepting the peritoneal fluid, showed belted, diplococcoid bacilli, found later to be *B. equisepticus.*

Tissues for histological examination were collected from (1) abscess wall left flank, (2) œdematous area heart wall, (3) spleen, (4) left kidney, (5) liver near whitish area, (6) liver including a portion of whitish area, (7) hemorrhagic lymph gland near kidney, (8) small intestine showing venous congestion. These were preserved in the usual fixatives.

Cultures were made from (1) coronary vein, (2) pericardial fluid, (3) peritoneal fluid, (4) right hock, (5) urine, (6) abscess, left flank, (7) pleural cavity, (8) posterior aspect, left lung, (9) spleen, (10) liver, (11) left kidney, and (12) hemorrhagic corpus luteum.

The results of the bacteriological findings were as follows:

B. equisepticus was isolated from an œdematous area of the jaw, abscess of right flank, joint fluid, heart's blood, jugular blood, pericardial fluid, pleural cavity, lung, peritoneum, spleen, liver and kidney. *B. pyrogenes equinus* was present in cultures from the œdema of the jaw and abscess of the right flank. *Diplococcus pneumoniæ* (?) was present in the cultures from the œdema of the jaw. Unidentified bacilli were present in the heart's blood and kidney.

Case (?) 16.—Aug. 19, 1902, this case was first seen by Drs. Brimhall and Wesbrook. The animal was a large bay horse, somewhat aged; awkward in his movements, but a good worker; broken winded. Blood was collected from this horse through an aspirating needle from the jugular vein, allowed to coagulate in a test tube, and the serum brought back to the laboratory, as a control for the Widal reaction (see page 337). He was one of a three-horse team unhitched from a binder at the time.

Sept. 7, 1902, the case was again seen by Drs. Brimhall and Wesbrook, accompanied by Dr. Torrance. The horse showed some

emaciation, but was not believed to be sick by Mr. P., who was working him steadily.

Temperature, pulse and respiration seemed to be normal. Some stiffness and swelling in the hind legs, especially in one; gait awkward, but not diagnostic of the disease.*

Case (?) 17.—This case was first seen by Drs. Brimhall and Wesbrook, Aug. 19, 1902. This horse, a large bay, was also one of a three-horse team taken from the binder.

Blood was collected from the jugular vein through an aspirating needle in the same way as in horse 16, and brought to the laboratory for Widal reaction.

Sept. 7, 1902, this case was again seen by Drs. Brimhall and Wesbrook, accompanied by Dr. Torrance. Mr. P. believed the horse to be suffering from the disease, and thought it would be only a matter of time until he has also succumbed. He was somewhat thin, had rather a suggestive gait; pale mucous membranes, but no ulcers. Temperature, 101.2; pulse, 44; respiration, 48. Dr. Torrance thought this a possible case. No specimens were collected.*

Case (?) 24.—This case was first seen by Drs. Brimhall and Wesbrook, Aug. 19, 1902. The animal was a mare, black broncho, age about eight years; very spirited. Attempt was made to collect blood from jugular, in the same way as from horses 16 and 17, but she was so vicious that it had to be abandoned. This indicates the state of her health at the time of visit. No number was given her at this time.

Sept. 7, 1902, the animal was again seen by Drs. Brimhall and Wesbrook, accompanied by Dr. Torrance. Mr. P. believed this horse to be suffering from the disease. She was thinner, seemed less spirited than on the former visit; was lame in left hind leg; swelling in flexor tendons; mucous membranes pale; no ulcers.

Temperature, 103.6; pulse, 44; respiration, 38.*

Outbreak VII.

Cases 13 *and* 25, *Sauk Rapids, Minn.*—Dr. S. H. Ward, V. S., had had cases under observation, on the farm of Mr. J. B. H., whose P. O. address is Sauk Rapids, for several months. From one of these, Case 13, he had forwarded on July 31, 1902, a bulb of blood.

Sept. 12, 1902, Drs. Brimhall and Wesbrook visited the farm of Mr. H. He had lost at least seven horses in the last seven years from this disease. He had a very good farm, and everything

*No further history of these animals could be obtained, and the diagnosis must remain in doubt.

seemed to be well conducted indeed. The buildings consisted of a brick house on one side of the road and opposite it a very comfortable frame barn. Both the house and barn are on the crest of a rolling hill. The whole farm consisted of rolling prairie with some scrub in the hollows; soil is sandy. With the exception of the possession of a flowing well, the conditions on this farm were quite different from those in the neighborhood of Beltrami, and the soil and situation of the buildings (height, etc.), were quite different. The barn was roomy; very clean; the floor was high and consisted of good, clean planking; the flowing well was on the opposite side of the road next the house, and was connected with a windmill. The only low land to which the horses had access was in the pasture, which lay in the rear of the barn. The premises were cleanly and the farm apparently very prosperous. Mr. H. also had a milk route in Sauk Rapids.

The history of the disease in all instances seemed to be that of a very chronic anæmia with emaciation, the appetite remaining good throughout. Profuse urination was given as a symptom.

Case 13.—This case was first seen by Drs. Brimhall and Wesbrook Sept. 12, 1902. The animal was a roan horse, age 14; weight, 1,400 pounds; sick one year; had gradually grown thinner, though the appetite was good. From this horse, on July 29th, Dr. Ward had forwarded a bulb of blood, as before stated. Notwithstanding the specific instructions given by Dr. Ward, the horse had been shot eight hours before autopsy by the hired man, i. e., about 1 o'clock a. m. after the return from an outing. The horse had been dragged into a wheat field about 200 yards from the barn, and therefore a windbreak was erected and the autopsy made *in situ*.

Autopsy.—9:30 a. m. Body was bloated to some extent, and in the peritoneal region and over the hind legs, as well as the sternum, there was evidence of swelling. On reflecting the skin a clear, yellowish, œdematous area was encountered over the sternum; also back of the shoulder and in the perineal region there was a layer at least three inches thick of a yellowish, gelatinous œdema which had given the rounded appearance to the hips. Hemorrhagic areas were found in the adductor muscle of the hip joint and on the shin bone of the right leg in the middle third. These latter were situated deeply, and could not have been due to traumatism. Similar lesions were encountered on the shin bone of the right foreleg. The synovial fluid from the left hock was much yellower than usual. All the subcutaneous tissues were de-

Barn of Mr. J. B. H——, Sauk Rapids, Minn., situated on high, sandy ground. The house and well are in front, on the other side of a main traveled road. Mr. H—— has lost several horses, although there is only one low, marshy piece of land in all his pasture, the barn and house being on a sandy hill. (Outbreak VII. See page 301 *et seq.*)

void of fat, and had a very marked yellowish or jaundiced tint, more marked than in any case hitherto examined.

Thorax.—Anterior mediastinum showed a very marked œdema, a yellowish general coloration and small hemorrhagic areas thickly studded it all over on the left border.

Pericardium contained a large quantity of clear, very markedly yellowish fluid, which suggested very strongly bile-staining or coloration from red blood corpuscles, though there were no clots or other evidences of hemorrhage. No blood.

The anterior portion of the heart showed a very great œdema in the auriculo-ventricular groove, and extending over an area of about six inches by three inches in diameter. It was possibly one-fourth to one-half inch thick. Weight of heart, 12 pounds. Heart muscle extremely pale, showing intramuscular hemorrhages, somewhat diffuse; sharply defined lesions were in the œdematous sub-epicardial tissues overlying anterior portion of the heart. There was œdema of both mitral valves and small hemorrhagic areas in one. Summary of heart: Pericarditis, endocarditis and hemorrhagic areas.

Lungs. A considerable amount of yellowish-green fluid was found in the pleural cavity. This was slightly flocculent, and, although there was no deposit of fibrin over the surface of the lung, there was evidence of pleurisy. Lungs were normal for the most part, except on the under portion of the lobe which lay next the heart, in which there was hemorrhage and some solidification in an area about two or three inches in diameter. This was dark blue in color. From it cultures and pieces for microscopic examination were taken.

Diaphragm. Appeared normal.

Abdomen.—There was some evidence of peritonitis. A foul gas and a yellowish-green, somewhat turbid fluid, escaped into the pipette by which culture material was collected. There were some fibrinous threads on the surfaces of the liver, spleen and other organs.

Liver. Weight over 25 pounds, therefore could not be exactly weighed. Capsule was not thickened, but the liver showed a very peculiar mottling, and to the hand presented abundant small hard areas, which through the capsule and on cut section could be seen as whitish rounded masses of connective tissue. The appearance suggested a biliary cirrhosis together with fatty degeneration.

Spleen appeared normal in appearance and consistency, but was enlarged. Weight, five pounds.

Kidneys. Left kidney, weight four pounds; showed petechial spots and hemorrhagic infiltration on capsule. Capsule not thickened, and was easily stripped, showing a very pale, yellowish cortex, which was increased in thickness and suggested parenchymatous nephritis. The medullary portions were beefy red and swollen in appearance, standing out in marked contrast to the paler cortex.

Right kidney. Weight, four pounds; showed also mottling.

The renal lymphatics in both kidneys were hemorrhagic and the glands somewhat enlarged.

Intestines. The small intestine appeared normal. On the large colon were two areas which showed a small neoplasm, possibly one-half inch in width and one-fourth inch in thickness. These were whitish in color, irregular in outline and firm in consistency and contained small, hemorrhagic areas. These may have been tumor formation or connective tissue growth around original hemorrhage. The softening observed in one may have been due to necrosis of the old hemorrhage. The vessels of the cœliac axis in certain portions of the distribution were very greatly thickened and almost occluded by what was either an organized blood clot (most probably) or an overgrowth of the connective tissue of the intima caused by *strongylus armatus*.

Direct coverslip preparations, tissues for histological examination and cultures were collected from the usual sources in the ordinary manner.

The results of the bacteriological examination were as follows:

B. equisepticus was obtained from the joint fluid, pericardial fluid, pleural cavity and lung. *B. coli communis* was present in the peritoneum. *B. subtilis* was found in the œdematus area over the sternum. *Diplococcus pneumoniæ* (?) was present in the lung, peritoneum and kidney. Unidentified bacilli were present in the liver.

Case (?) 25.—This case was first seen by Drs. Brimhall and Wesbrook Sept. 12, 1902. Black mare, seven or eight years old; had been sick for almost a year; growing steadily thinner, though she eats well. Was used for spring work, but since then could not stand work; coat rather staring; mucous membranes very pale in eye, nose and mouth; pallor most marked of any case hitherto seen. It was stated that the horse used to sweat in patches; history of very abundant urination at infrequent intervals; the amount passed, however, seemed to be greater than

"SWAMP FEVER" CASE 25.

This black mare, aged eight years, belonged to Mr. J. B. H——, Sauk Rapids, Minn. She had been sick for nearly a year when the photograph was made, on Sept. 12, 1902, and, the decline steadily progressing, she died a few weeks later. (Outbreak VII. See page 304.)

normal. Two patches of œdema about three by six inches were noticed on each side of the median line. They were not over one-twelfth inch in thickness, however. Œdema marked in both hind legs, possibly from standing on wooden floor. Observations on pulse, respiration and temperature were made at 9 a. m.

Pulse, 55; anæmic thrill. Respiration, 14. Temperature, 101.4.

The following specimens were collected:

1. From the jugular vein about 10 c. c. of blood was drawn by means of an aspirating needle into a flat flask containing 70 c. c. of broth. This was thoroughly shaken, and about 5 c. c. of the mixture expelled through the tube, so as to rid it of the solid blood which it contained, and both tubes were sealed up in the flame. This showed no bacteria in any cultures.

2. A small amount of slightly bloody fluid, impossible of estimation, was drawn into a flat flask containing 80 c. c. of broth from the œdematous area over the sternum. Practically no fluid was obtained, and it is very probable that the culture from this source was contaminated, owing to the difficulties met with in aspiration. This showed staphylococci in direct coverslip preparations and in cultures.

3. Blood for counting. Coagulated when received in laboratory.

4. Blood for Widal reaction in double ended tube.

5. Hæmoglobin (Tallquist) was 45 to 50.

This horse died Oct. 2, 1902.

Outbreak VIII.

Cases 19, 20, 21 *and* 22, *Beltrami, Polk Co.*—Aug. 26, 1902, Drs. Brimhall and Wesbrook visited the farm of Mr. P. M. Mr. M.'s farm is situated on the west side of the G. N. Ry. track and two miles south of Beltrami. He had lived on this farm about six months, but lost horses from this disease for the last year when living north (?) of Beltrami. He gave a history of having lost six horses with this disease in the last 18 months. This farm was supplied with running water from an artesian well. The soil is a dark loam, overlying clay, and the situation of the buildings is such that drainage is practically impossible. The barn in which the horses stood was kept in a very good condition and was floored, differing in this respect from that in Outbreak VI. Last year Mr. S. lived on the farm and also lost some horses.

At the time of the visit Mr. M. had one horse (19) which seemed to be so crippled as to be useless, according to his past experience,

in which he had had but one recovery (broncho). He was working two others, both of which he thought were coming down with the disease (20-21). He also had on his place Case 22, belonging to Mr. B., which he thought was afflicted with the disease, making four in all at the time of the visit, Aug. 26, 1902.

Mr. M., without suggestion, spoke of profuse urination as a frequent symptom, and Dr. Bertelson of Beltrami spoke of this being a matter of common report.

Case 19.—Seen first by Drs. Brimhall and Wesbrook on Aug. 26, 1902. Bay, white face, 14½ hands, 20 years old. Had swollen left hind leg for a number of years, but in spite of this has been a good worker. Five days ago had to stop work on account of acute swelling and lameness in this enlarged leg. Three days later some swelling and extreme lameness were noticed in the left shoulder joint. This had remained, so that at time of observation he could scarcely move. Appetite good; lost some flesh, however. Pallor of mucous membrane, peculiar yellowish tint. Ulcer of mucous membrane, lower lip. Oedematous swelling between front legs and also over left shoulder joint.

Pulse, 60 at 10 a. m. Dr. Brimhall noticed an anæmic thrill. Temperature, 102.6. Respiration, 20.

At this time he was shot, and immediately afterwards the following specimens were collected:

Blood from jugular vein.

Blood for Widal test in tubes with both ends open, plugged with cotton.

Blood smears for microscopic examination. (Jugular vein.)

Blood for counting. (Jugular vein.)

Hæmoglobin, 40 (Tallquist). Red blood cells, 1,812,000. Leucocytes, 47,000; counted Aug. 27, 1902.

Autopsy.—Peculiar yellowish tint to all fat-bearing connective tissue. Left shoulder showed œdema which was hemorrhagic in its borders. In the joint was a large quantity of fluid; over the chest was an œdematous hemorrhagic area observed during life. An abscess was observed in the sheath of the tendon of the biceps of left leg. Erosin of bicipital groove in head of humerus. The left hind leg, which had been enlarged so long showed a very hard, firm white connective tissue and perforating here and there in small bunches or nests were dilated lymphatic sinuses. The left iliac vein and branches were occluded for several inches with thrombi.

The barn of Mr. P—— M——, two miles south of Beltrami, where cases Nos. 19, 20, 21 and 22 occurred. The horses were stabled in that portion of the building reached through the door at the left hand side. The stable is located on rather low ground. The well, not shown in the picture, is further to the right and in front of the barn. (Outbreak VIII. See page 305 *et seq.*)

Thorax.—The pericardium contained a large quantity of clear, yellowish fluid.

Heart showed œdematous area over auriculo-ventricular groove. Deep in ventricular muscle were small hemorrhagic areas. Hemorrhagic areas and yellow gelatinous exudate in posterior mediastinum behind apex of heart.

Lungs did not show marked hemorrhagic areas, though there were a few purplish semi-solid patches. No visible pleurisy except roughening over patches.

Diaphraghm, normal.

Abdomen.—Some yellowish fluid, slightly gelatinous in consistency and turbid, found in peritoneal sac.

Liver showed possible parenchymatous inflammation.

Spleen appeared normal except for a very few minute purplish hemorrhages (?) under capsule.

Kidneys appeared swollen and to be affected with parenchymatous nephritis. The capsules stripped too easily.

Bladder contracted and containing only a small amount of urine, though sufficient for cultural purposes and to collect a sample for chemical examination.

Direct coverslip preparations, tissues for histological examination and cultures were collected from the usual sources in the ordinary way.

The results of the bacteriological examination were as follows: *B. equisepticus* was obtained from the œdema of the chest, œdema of the left shoulder joint, abscess of the biceps, from the joint fluid, from the heart's blood, from the pericardial fluid, from the spleen, liver and urine. *B. subtilis* was obtained from cultures from the œdema of the chest, œdema of the left shoulder joint, lung, spleen and kidney. *B. coli communis* was present in the cultures from the peritoneum. Streptococci were present in the abscess of the biceps.

Case (?) 20.—This case was first seen by Drs. Brimhall and Wesbrook Aug. 26, 1902. It was a horse 16½ hands, six years old. It seemed to have been out of sorts for some days. Mr. M. thought he was coming down with the disease for the past four days, though he was still working on the binder. Mucous membrane anæmic; no ulcers.

Temperature, 102. Pulse, 68.

Hæmoglobin, 80 (Tallquist). Red blood cells, 5,564,000. Leucocytes, 48,000. Counted Aug. 27, 1902.

Materials were collected for examination as follows:

1. Blood smears.
2. Blood culture into flask directly through aspirating needle; shaken up; small portion blown out into test tube. Whilst labeling, the flask broke. The broth tube, however, had been made before this time and remained sterile. (See Table II., p. 343.)
3. Blood for Widal in open tube.
4. Blood for counting.

Sept. 7, 1902, the case was seen again by Drs. Brimhall and Wesbrook, accompanied by Dr. Torrance.

Mr. M. stated that horse seemed to be recovering. The horse showed emaciation still, had a peculiar swinging gait and a little uncertainty in his walk. His coat was pretty good but "greasy" (Torrance). His hind legs were "stocked." Ulcer on the mucous membrane of the lower lip was almost healed; mucous membrane had become less blanched. Horse appeared lively.

Pulse at 12 M., 56. Respiration, 20. Temperature, 101.2.

The horse went down on Saturday evening, January 10th, and died Jan. 12, 1903, sometime in the afternoon. Dr. Annand held an autopsy Jan. 14, 1903, at 11 a. m. The body was somewhat frozen and was out in the open prairie with wind and snow blowing at the rate of 40 miles an hour—a "blizzard."

Dr. Annand secured specimens from the lung, heart, liver and spleen. The horse evidently had some form of pneumonia at the time of death, because the owner said there was a bloody serous discharge from the nostril. The heart was pale and had apparently hemorrhagic areas on the surface. The pericardial sac contained a large amount of bloody serum. The liver was pale and shrunken. The small colon had on different parts of its course hemorrhagic areas varying in size from a dollar to a space three by three inches.

The results of the bacteriological findings were as follows:

B. equisepticus was obtained from the cultures from the heart's blood. *B. subtilis* was obtained from the cultures from the heart's blood, spleen and liver. *B. coli communis* was present in the cultures from the spleen and liver.

Case (?) 21.—This case was first seen by Drs. Brimhall and Wesbrook, on Aug. 26, 1902. The horse was 10 years old, 17 hands high; a bright bay, white face. Had been ailing for ten days. However, still at light work. This horse was ordinarily very high spirited, but appeared to be apathetic at this time. The animal

had been getting steadily thinner. Had weighed 1,600 pounds, but would not weigh at the time, more than 1,200 pounds.

Temperature, 105°; pulse, 70; respiration, 35, after resting one and one-half hours from work.

Hæmoglobin, 65 (Tallquist). Red blood cells, 4,576,000. Leucocytes, 51,000 (counted Aug. 27, 1902).

The mucous membrane was anæmic, one ulcer on lower lip. Was photographed, but tried to roll during the photographing showing that he had not lost all his spirit. Ate well.

Blood for culture, blood smears for microscopic examination, blood for Widal test, and blood for cell counting was collected. The blood cultures showed only *stapyhlococcus pyogenes albus*.

Sept. 7, 1902, Drs. Brimhall and Wesbrook saw this case a second time with Dr. Torrance. Mr. M. stated that the horse was better, and that he had used him for hauling hay. Mucous membranes were better color, and he appeared to be recovering. Ulcer on the lower lip had healed over, and only a slight cicatrix remained. Coat was dry and staring.

Pulse, 48 at 12 m.; respiration, 16; temperature, 100.2.

Dr. Annand saw this case, on Jan. 12, 1903, at which time his condition and appetite were good. His pulse was 43, respiration 18, and temperature 100.2. He had a slightly vacillating or staggering gait.

Case (?) 22.—This case was first seen by Drs. Brimhall and Wesbrook, Aug. 26, 1902. The animal belonged to Mr. B., of Beltrami, but was kept by Mr. M., on his farm. Roan, about 14½ hands high; age 10 years. Been out of condition for a week; getting thin; eats well. Mucous membrane anæmic; one small ulcer, lower lip.

Temperature, 103.5°; pulse, 62; respiration; hæmoglobin, 70 (Tallquist).

Specimens were obtained as follows:

Blood cultures, blood smears for microscopic examination, and blood for Widal test. The blood cultures showed no growth.

Sept. 7, 1902, Drs. Brimhall and Wesbrook, accompanied by Dr. Torrance, again saw this case. Mr. M. stated that this horse was temporarily better. Had been worked one day and driven to town. Skin in better condition than Case 21. Mucous membrane pale. Urination more profuse than usual. "Gait not characteristic" (Torrance). Hind legs swollen from hock down.

Pulse at 12 m., 48; respiration, 18; temperature, 100.2°.

Jan. 12, 1903, Dr. Annand received from Mr. M., information that this horse had been traded off to Mr. F., of Fertile, Minn., and that the animal looked very bad about a week before.

Outbreak IX.

Case 23, Beltrami, Polk Co.—Sept. 8, 1902, Drs. Brimhall, Torrance and Wesbrook visited the farm of Mr. LeF., on whose farm Case No 23, was being kept. Mr. L., lives about four miles northwest of Beltrami. The general surroundings, character of the soil, possession of flowing well, were all somewhat similar to those in Outbreaks II., VI. and VIII., and of Mr. McM.'s farm. The general topography was, perhaps, slightly different. Mr. L. lived farther west than any of the gentlemen mentioned. There was no history of the disease having appeared on his farm before.

The horse in question was one which, according to Mr. M., had been showing the disease for six months and had been traded to Mr. L. on this account. Mr. L. apparently thought the animal was not well because she was kept in a different stable from his other horses, which all appeared to be lively, and in good condition, also well cared for.

The mare was nine or ten years old, grey in color, and about 15 hands high; weight approximately, 1,100 pounds. She appeared to be not emaciated; the coat was not in bad condition; her appetite was said to be good, and she was quite lively, being quite willing to walk, or even to trot without persuasion. She had no characteristic gait.

On examination her flesh appeared very flabby, and it was said that she could not stand hard work. Mr. M., expected that she would not recover, and Mr. LeF. was expected to get rid of her. There was distinct œdema in the lower eyelid and some œdema in the legs. The membranes of the eyes and nose appeared to have a temporary hyperæmia. Dr. Torrance thought there might be some fluid in the peritoneum owing to the shape of the belly.

Temperature, 103.2; pulse, 58 with anæmic thrill; respiration, rapid, 20-22.

Red blood cells, 2,352,000; leucocytes, 7,000; hæmoglobin, 65 (Tallquist).

Direct coverslip preparations and cultures were made from the blood. The direct coverslip preparations showed no bacteria. The cultures showed a spore-bearing bacillus (probably a contamination).

On Jan. 12, 1903, Dr. Annand obtained the further information that the horse had been taken to Brainerd, where—when last seen, she seemed to be in very poor condition.

Outbreak X.

Case 26, Crookston, Polk Co.—This case was first seen by Drs. Brimhall and Beckman, Oct. 1, 1902. The horse was the property of Mr. J. V., who lives on low, level land, eight miles east of Crookston, Minn. This was a five year old black gelding, weight about 800 pounds. Had been sick about five weeks. Pulse, 84; temperature, 87.2. The mucous membranes were colorless. Emaciation was quite marked, and in backing out of the stall, it showed weakness, and a disinclination to turn short, groaning whilst turning, as though in pain. There was dullness over the lower part of the lungs. Had "wobbling" gait. The blood as taken from the facial vein was very light colored. Blood count; red cells, 798,000; leucocytes, 5,000; hæmoglobin, 20 (Tallquist).

Horse was killed by shooting, and an autopsy made at once.

The blood flowing from the large blood vessels which were cut showed a marked disinclination to clot, and was extremely pale and watery.

Nothing abnormal was found when the skin was removed. In the pleural cavity a number of large areas of hemorrhage were found on the diaphragm and the parietal pleura. These areas were made up of a collection of very small points of hemorrhage. There was about a gallon of a straw colored effusion in the pleural cavity. There was a collection of fibrin around the region of the pericardium and the fat about the pericardium was of a peculiar lemon color. There were also a few points of small hemorrhages in this. The pericardium contained about a quart of straw colored fluid. The heart, weighed 14 pounds. Heart wall showed many minute hemorrhages, both on the epicardial and endocardial surfaces. The pericardium contained about a quart of straw colored fluid. The lower lobe of the left lung was much thickened and apparently œdematous and consolidated. There were also large areas of consolidation scattered over the lower portion of the anterior lobe. In cutting through this lung it showed red and grey hepatization, and also a marked œdema in that lower portion previously mentioned. The right lung showed no œdema, but there was a considerable area which was consolidated much like the left lung. The connective tissue in the consolidated portion of the lung had a translucent yellow appearance, like rancid fat. The liver showed a number of points of adhesion on its capsule, and when cut into the hepatic vein contained organized clots. Its weight was 16 pounds. The spleen was about normal in color and consistency, although the thickness of the pulp varied greatly in different areas. About the center it was very thin. The weight of the spleen was two pounds. Left

kidney weighed one and one-half pounds, and the right kidney one and three-fourth pounds. They were extremely pale throughout, there being very little difference in the color of the cortical and medullary portion. The intestines were normal with the exception of a few peritoneal adhesions.

Direct coverslip preparations, tissues for histological examination and cultures were collected from the usual sources in the ordinary manner.

The autopsy was made in a very dusty barn, while a high wind was blowing. The cultures showed a great variety of bacteria. Streptococci, *B. coli communis* and eight other kinds of bacilli were found in the cultures. These were probably mostly contaminations. *B. equisepticus* was not isolated, though in the mixed cultures, bacilli morphologically indentical with it were frequently met with. It must be remembered that the isolation of an organism like *B. equisepticus*, from cultures containing also several other species of bacilli, some of which are motile, is extremely difficult and sometimes impossible.

No further information has been received concerning other cases on Mr. V.'s farm.

Outbreak XI.

Case 27, *Litchfield, Meeker Co.*—Oct. 3, 1902, Drs. Brimhall and Beckman visited the farm of Mr. M. A. McG., ten miles south of Litchfield, Minn. Information in regard to the disease existing on this farm came from Dr. Peters, veterinarian, at Litchfield, Minn. He states that a disease similar to the present disease has existed on this place for a period of ten or twelve years, ten to twelve horses having died in that period of time. Dr. Peters says that he has seen from 30 to 50 cases of apparently the same disease in the six years that he has been in Litchfield, most of the cases being fatal.

Case 27.—This was a black mare, nine years old, weight about 1,400 pounds when in good flesh. The animal at this time was very thin. It gave a history of gradual falling away for the last four weeks or longer. It had not been worked since harvest. Appetite had been good until the last two weeks.

There were several œdematous swellings under the belly, and on both fore and hind legs.

Pulse, 80; temperature, 103.7; hæmoglobin, 35 (Tallquist).

All the mucous membranes were very pale. There were several ulcers on the lips about the tongue, and one large elevated ulcer upon the back of the mouth.

Horse was killed by shooting. The œdematous areas on the belly and on the legs contained a clear straw colored fluid. No other lesions were found in the skin and subcutaneous tissues. The pleural cavity was apparently normal, as were also the lungs. They did not collapse, but this was due to the blood which was in the trachea. The pericardium was apparently normal and contained the usual amount of fluid. The heart was large and solid, and weighed 12 pounds. It contained an infarct on its surface about one-half inch in diameter. One leaflet of the auriculo-ventricular valve was firmly adherent to the endocardial surface which probably accounted for the increase in size in the heart. The liver weighed 25 pounds; capsule was thickened, and showed evidence of old inflammatory adhesions. On section the liver tissue was yellower than normal and showed an increase of connective tissue. The spleen weighed seven pounds, was thicker and larger than normal, and in one place showed a raised area about one-half inch in diameter, which contained the normal spleen pulp, with more blood than the other portions of the spleen, which seemed to be a hemorrhage under the capsule of the spleen. There was a chronic peritonitis especially marked about the region of the cæcum. In the mesenteric artery a large organized clot was found, which contained several worms about the size of a pin, pointed at both ends, and one-half inch long, probably *strongulus armatus*. The right kidney weighed three pounds; was very pale throughout. Bladder appeared to be normal.

Direct coverslip preparations, tissues for histological examination and cultures were collected from the usual sources in the ordinary manner. On examination of the cultures, *B. equisepticus* was isolated from the spleen, liver, heart's blood and heart wall, *staphylococcus pyogenes albus* from the pericardial fluid and heart's blood, *diplococcus pneumoniæ* from the heart's blood, *bacillus subtilis* from œdema of the belly wall, *B. coli communis* from œdema of the belly wall and two unidentified bacilli, (probably contaminations), from the heart's blood, spleen, pericardial fluid, pleural fluid, heart wall and liver.

Outbreak XII.

Portage la Prairie, Canada.—Oct. 15, 1902, Drs. Brimhall and Wesbrook went to Manitoba on the invitation of the authorities to hold an autopsy upon an acute case of swamp fever at Portage la Prairie. The case died before their arrival, but too late to notify them by telegram. The carcass had already been disposed of. The farmer who owned this horse had lost 16 out of 18 horses.

Case (?) 28.—There were present at the examination and autopsy of this case Drs. Torrance and Bell of Winnipeg, Drs. Hilton and Taylor of Portage la Prairie, and Drs. Brimhall and Wesbrook of Minnesota.

Past history of horse. Bay, 10 years old; weight, 1,400 pounds. Belonged to Mr. A. H. C., who lives near Portage la Prairie. Horse had been sick two months and had done no work since seeding. He was said to have lost flesh since that time. He had been brought to Dr. Taylor one month ago with a temperature at that time of 105°. A diagnosis of malaria or swamp fever was made, and iron and arsenic prescribed with a resulting temporary improvement. No treatment had been given for two weeks.

Present condition. Oct. 18, 1902. Horse not emaciated; coat somewhat harsh, though it could not be described as staring.

Pulse, 60; temperature, 100.4 F.; respiration, 16.

Mucous membranes slightly pale. Legs slightly "stocked." No other œdema. The horse was seemingly in good spirits. Some muscular weakness with "staggering" gait.

Blood count—Facial vein, red blood cells, 6,400,000 (Bell); leucocytes not counted; hæmoglobin, 70 (Tallquist).

The case was not considered typical by the Manitoba authorities, who looked upon it as a convalescent case. Horse was killed by shooting at 2:45 p. m.

Autopsy.—Autopsy was held in a box stall upon the floor of which sawdust was sprinkled. One window was open. Considerable dust present.

Subcutaneous tissue showed some yellowish fat. Muscular tissue, dark, like Case 15. No œdematous patches except for slight infiltration below the hock. This, however, was not gelatinous and was not circumscribed.

Thorax.—Anterior mediastinum showed some enlarged hemorrhagic lymph glands. No marked œdema.

Pericardium contained about normal quantity of clear yellowish fluid. It was not blood-stained.

Heart. Weight, 8 pounds 7½ ounces. A few tiny petechiæ on the surface. Right auricle showed Zenker's waxy degeneration of one of the columnæ carnæ. There was present also a small aneurism about one-half inch in diameter. This was thin and apparently covered only with a serous covering, and projecting one-quarter inch in a conical form. It was situated within one-half inch of the degenerated muscular column.

Lungs. Normal in color and appearance with the exception of two or three small purplish areas which looked to be collapsed. No pleurisy; no excess of fluid.

Diaphragm normal, except over liver, where it was somewhat roughened. (See liver below.)

Abdomen.—There were some evidences of peritonitis, if white lymph flakes over the surface of the liver and intestines can be so considered.

Liver. Weight, 19½ pounds. Normal in color, but with large lymph flakes on surface and one roughened area four inches in diameter next to diaphragm. In the right lobe were several small calcareous concretions about one-fourth inch in diameter and rounded in shape. There were present one or two small cyst-like areas, apparently with white fibrous walls. These were not more than one-sixteenth to one-eighth inch in diameter, and it was suggested that the calcareous areas had originated as cysts. The calcareous and cystic areas were preserved for examination.

Spleen. Weight, seven pounds two and three-quarter ounces. Surface smooth and mottled. Apparently normal except for increase in size. Near the spleen and in the attached mesentery were several swollen hemorrhagic lymph glands.

Mesenteric artery showed in one area a small thrombus, and the presence of slender worms about one-half to three-quarters of an inch in length.

Intestines normal, excepting the large colon, which was covered with lymph flakes and contained one gelatinous hemorrhagic area about two inches in diameter and one inch in thickness.

Peritoneum showed small hemorrhages on lower body of surface.

Left kidney. Weight, two pounds one ounce. Right kidney weighed two pounds two and one-half ounces. Both appeared normal. The abdominal fat and omentum were bright yellow in color.

Direct coverslip preparations, tissues for histological examination and cultures were collected from eleven sources in the usual manner.

The bacteriological examination showed staphylococci from the pleura, four species of unidentified bacilli from the pleural cavity, a fifth species from the lung and a sixth from the kidney. *B. equisepticus* was not found, but it must be remembered that this case was recovering or had recovered. Cultures from eight sources remained sterile.

Outbreak XIII.

Case 29, *Winnipeg, Canada.*—Oct. 20, 1902. This case was seen by Drs. Bell, Torrance, Martin, Brimhall and Wesbrook. The horse belonged to Mr. C. Had been quite sick for two months. Two weeks before was considered a typical case of "swamp fever" by Dr. Martin, who is treating her. He thought that she was recovering October 20th. Mare, six years old, bay, weight 1,200 pounds.

Temperature, 100; pulse, 48.

Mucous membranes pale; coat shows nothing characteristic; no œdematous patches; no special weakness.

Blood count (made by Dr. Torrance), red blood cells, 5,683,000; leucocytes not counted. Hæmoglobin, 70 (Tallquist).

Blood in direct coverslip preparations for cultures and for Widal tests was collected.

The cultures showed no growth.

Outbreak XIV.

Cases 30, 31, *Russia, Polk Co.*—Thursday, Oct. 23, 1902, Drs. Brimhall and Wilson visited the farm of Mr. A. B. A., three miles east of Russia, Minn., and collected specimens from horses, Cases 30 and 31.

The locality visited is about six miles north and 3 miles east of Beltrami, Minn., the site of previous cases. It is in the Red River Valley, but near no small stream. The land is the rich black Red River soil, lacustrian in formation, and containing very little sand, being locally known as "gumbo." The house and barn were fairly well drained. The stable was dark and rather dirty. It contained 12 horses in all, four of which had been sick during the past three months. Two of these, a colt and a small gelding, were so far recovered that their temperatures were normal, and showed no symptoms whatever.

Case 30.—White mare, age 10 years, weight about 1,400 pounds. Had been sick about 12 weeks, and was apparently recovering. Temperature, 102; pulse, rate 52. The parotid glands were enlarged, though this was probably due to melanosis. The legs were badly "stocked," and there was marked œdema of the chest and belly. On closer examination the swelling on the chest was found to be due in part to an abscess. Appetite was good.

Direct coverslip preparations and broth and agar cultures were made from the abscess and the œdema of the belly wall, by shaving over the parts, washing off with alcohol and burning through with platinum spear. Hæmoglobin, 50 per cent (Tallquist).

Cultures from the œdema of the belly wall showed no growth. The broth culture from the abscess of the chest contained a small, slender, non-motile bacillus.

Case 31.—The fourth animal sick on Mr. A.'s place was a ten-year-old bay mare which had weighed when in flesh about 1,350 pounds. She had been sick about ten weeks. On the day observed she was very much emaciated and scarcely able to stand, being apparently weakest in the posterior extremities. The mucous membranes were very pale.

Pulse, 76; temperature, 102.6; red blood cells, 5,420,000; leucocytes, 4,200.

Had marked œdema over chest and abdomen and running down both fore legs. The animal was killed by shooting in the head, and an autopsy made at once.

No abscesses were found, and the œdematous areas over the chest and abdomen and over the fore legs contained only serum. Well marked hemorrhagic areas were found over the ribs under the left foreleg. Small hemorrhagic areas were found scattered over both lungs and along the line of the auriculo-ventricular groove of the heart, in the spleen and the cortex of both kidneys. There was evidence of peritonitis over the liver and small intestines. Branches of the middle mesenteric artery were thrombosed. The heart weighed 8 pounds; spleen, 5 pounds; liver, 22 pounds; right kidney, 2¼ pounds, and the left kidney 2¼ pounds.

Direct coverslip preparations, tissues for histological examination and cultures were collected from the usual sources in the ordinary manner. On examination of the cultures, *B. equisepticus* was found in the joint fluid, heart's blood, pleural cavity, lung, peritoneal gland, spleen and liver. Staphylococci and an unidentified bacillus were present in the culture from the jugular blood. *B. subtilis* was present in the culture from the œdema on the right leg.

Outbreak XV.

Cases 32, 33, *Polk Co.*—Oct. 30, 1902, Drs. Brimhall and Wilson visited the farm of Mr. A. J. A., two miles northwest of Fisher, Minn., for investigation of swamp fever. Mr. A.'s farm is in the Red River Valley, is of lacustrian formation, lies high with no swamps, and has been under cultivation since 1881. His water supply is surface wells. The horses have been in pasture, principally on clean timothy of fine quality. Six years ago Mr. A. lost one horse with what he considered the same disease as that with which his animals are now suffering. He gives the following

history of this animal: Strong horse, apparently perfectly well throughout the whole of the summer. Taken suddenly ill after a day of not unusually hard work. Grew rapidly emaciated, continued so, though eating freely until he died, 61 days after the beginning of his illness.

Five years ago another horse died with similar symptoms. In the fall of 1901 two others died with the same symptoms, and during the summer three, prior to Drs. Brimhall and Wilson's visit, had died.

At the time of the visit two horses were sick. These were both examined, and are Nos. 32 and 33, swamp fever series.

Case 32.—Examined Oct. 30, 1902, by Drs. Brimhall and Wilson.

Large dark bay horse, age 10 years. Has always been strong and perfectly well until one week ago, when he grew weak behind and began to be emaciated, though his appetite remained good. To-day animal appears listless, scarcely able to walk. Was much emaciated but nibbled at food. Temperature, 104; pulse, 72 and very weak.

Case 33.—Drs. Brimhall and Wilson saw this case Oct. 30, 1902. The animal was a two-year-old bay colt. It came of good stock, and had been in perfect health until six weeks ago, when it suddenly became ill, as shown by symptoms of weakness and uncertain gait, especially in posterior extremities. Appetite remained good and animal became emaciated, and then again picked up flesh apparently. Had been able to walk on previous day, and hobbled out into the pasture about one-half mile from the house. There got down and was unable to rise. Temperature, 103; pulse, 70; extremely weak; Hæmoglobin, 40 (Tallquist).

Blood collected for counting showed later 5,800,000 red blood cells; leucocytes, 3,600.

The animal was killed by shooting and bleeding, and a post-mortem examination made at once.

The apparently good condition of the animal was found to be due to œdema over the belly and sides of the body, including the ribs. In several places, especially under the belly, the elsewhere yellowish exudate was hemorrhagic. The inguinal glands were swollen and filled with small hemorrhages.

The lungs showed most intense pleural hemorrhages which extended into the lung along the interalveolar connective tissue. So dark was this that the whole of both lungs resembled, before cutting, a lung in the acute stage of pneumonia. Incision, however, showed that it was not pneumonic.

Pericardium showed several small hemorrhages, and the pericardial fluid was increased in quantity, though clear.

The heart was enlarged, soft and flabby. Externally the heart showed but little hemorrhage, though yellow œdema was present in the auriculo-ventricular groove. On opening the left heart, the entire inner aspect of the wall was found to be covered with dark hemorrhagic areas.

The spleen was about normal in size but somewhat softened. It contained a number of pale-colored infarcts.

The liver was markedly enlarged and congested. Flakes of white, coagulated exudate from acute peritonitis covered its surface.

The pancreas showed small hemorrhages throughout the gland.

The stomach wall was slightly, and the entire intestine markedly covered with sharply defined petechial hemorrhages. An aneurism, two inches in diameter, was present on one of the branches of the middle mesenteric artery. The walls of the aneurism were about one-half inch thick, and the sac contained several small worms (*strongulus armatus ?*).

An acute parenchymatous nephritis was present in both kidneys. The cortex showed, beside diffuse inflammation, numerous hemorrhagic infarcts.

The bladder was distended with apparently normal urine.

The weight of the organs was as follows: Spleen, 5 pounds; right kidney, 3 pounds; left kidney, 3 pounds; heart, 6 pounds, and liver 24 pounds.

Direct coverslip preparations, tissues for histological examination and cultures were collected from the usual sources in the ordinary way.

B. equisepticus was isolated in the cultures from the spleen and liver. An unidentified bacillus was present in the cultures from the œdema of the belly wall and from the liver. Another unidentified bacillus was present in cultures from the lung, heart's blood and spleen.

Outbreak XVI.

Cases 34, 37 *and* 38, *St. Cloud, Stearns Co.*—Nov. 22, 1902, Drs. Brimhall and Beckman visited St. Cloud.

Mr. H.'s place, which is nine miles north of St. Cloud, formerly belonged to Judge S. Mr. H. bought the place, a farm consisting of 1,200 acres, some months ago and moved his stock down (including swamp fever cases 34-37-38) Nov. 8, 1902. All three

animals were below par before he moved. The present farm is on high ground, sandy loam, and so far as its arrangements are concerned, is up-to-date in every respect.

The horses came from Mr. H.'s former farm near Hallock, Kittson Co., Minn. This place was considered better than the average in that vicinity, but the buildings were located in what appeared to be an old dry run. The probable reason for selecting this place for the stables was on account of the shelter for cattle and other animals. All of the land in this vicinity is very black, heavy soil with streaks of gumbo.

Case 34.—This case was a bay Clydesdale mare, five years old. Mr. H. says that this mare was taken sick early last spring with what he considers the same disease as the present, and was treated to repeated doses of physic and seemed to recover, remaining well until late this summer. He states that the mare was sick when brought to St. Cloud, and was brought thinking that perhaps the veterinarian there might be able to make a diagnosis and perfect a cure. Mr. H., states that in the past 14 years he has lost between 15 and 20 horses with what he believes to be the same disease, this horse being the third this summer to die. Since being brought to St. Cloud two weeks ago, the horse has been in a livery barn under the care of Dr. Ward.

The following were Dr. Ward's notes, taken on Nov. 10, 1902:

Temperature, 102.2-5; pulse, 96.

Symptoms. Anæmia, staggering gait, swelling along abdomen. Treatment. Potassium iodide and iron. No improvement in temperature or pulse. Condition remained the same, but the swelling had lessened on the 17th. The temperature on that day was 104.1-5°. There were no changes in the symptoms up to the present time, except increasing weakness.

The mare was led out into the country about two miles, into a small ravine in a pasture, and killed by being shot.

Hæmoglobin, 45 (Tallquist).

The swelling along the abdomen contained a clear straw-colored fluid.

The lungs were covered with small hemorrhagic spots about the size of a pea, and in a few places, a gelatinous straw-colored exudate mixed with blood. No hemorrhages were found on the costal pleura.

The heart contained an infarct one-half inch in diameter. Otherwise the heart muscle seemed firm and normal. The heart valves were thickened along their margin. Heart weighed eight pounds.

The pericardium contained about four ounces of dark blood-streaked fluid.

The liver was cirrhotic and felt as though the capsule contained small lumps, about the size of marbles. Weight, 28 pounds. On section the liver tissue was bile-stained, the connective tissue showed plainly, and the larger vessels were filled with organized clots. The surface of the liver, spleen, and all the abdominal visceræ was covered with small flakes of fibrin showing recent peritonitis. There were no adhesions.

Spleen was pale in color. Weight, four and one-quarter pounds.

The kidneys were apparently normal. Weight, two and one-quarter pounds each. An organized clot was found in the mesenteric artery, which contained several small worms one-half inch in length. Many worms from two to three inches in length were found attached to the inner surface of the small intestines. Mr. H. believes that these worms are always present in this disease, he having performed several autopsies upon horses dead of this disease.

Direct coverslip preparations, tissues for histological examination and cultures were collected from the usual sources in the ordinary manner.

On examination of the cultures, *B. equisepticus* was found in those from the liver, *B. subtilis* in those from the spleen, streptococci from the pleural cavity, liver and kidney, staphylococci from the joint fluid and an unidentified bacillus from the heart's blood.

Case 37.—Clydesdale gelding, four years old, shipped to laboratory while still alive. Received Feb. 5, 1903.

OBSERVATIONS ON CASE NO. 37, IN RESEARCH LABORATORY.

Date.	Hour.	Rectal Temperature.	Pulse.	Respiration.	Remarks.
2-5-03	9 a. m.	102.8	....	....	Oedema of legs and sheath. Pale mucous membrane. Loss of appetite. Polyuria.
2-6	9 a. m.	102.2	70	18	
	5 p. m.	101.6	....	....	
2-7	10:30 a. m.	....	....	....	Blood culture showed B. equisepticus pure. Hb. 30 (Tallquist). R.b.c. 1,414,000. Leuc. 3,000.
	11:30 a. m.	101.4	....	....	
	5:05 p. m.	103.2	....	....	
2-8	10:15 a. m.	101.6	....	....	
2-9	10:20 a. m.	100 4	90	....	Large oedematous patch over belly, anaemic thrill over heart.
	4:30 p. m.	103.6	....	....	
2-10	9:30 a. m.	103.2	....	....	Animal down at 3 p. m.
	4:30 p. m.	101	....	....	
2-11	10:15 a. m.	98.8	....	....	Blood culture showed B. equisepticus pure. Hb. 20-30 (Tallquist). R.b.c. 1,588,000. Leuc. 4,000. Oedema of belly wall disappeared.
	3:45 p. m.	....	....	....	Dead.

The animal died at 3:45 p. m., Feb. 11, 1903. No subcutaneous lesions, excepting a few small hemorrhages about the root of the tail.

Lungs.—The right lung was pale throughout, excepting a few small, clearly defined hemorrhages. The left lung was dark colored, due to hypostatic congestion, and over its surface there were many spots of yellow exudate.

The pericardium contained a very large amount of clear straw-colored fluid.

The heart muscle was firm and contained many large and small hemorrhages on both the internal and external surfaces. Heart, weight four pounds.

The diaphragm and the costal pleura contained many small hemorrhages.

The spleen was apparently normal in size and consistency, weight four pounds, and contained many clearly defined hemorrhages about the size of a pea. The liver was apparently normal. The intestines contained many hemorrhagic areas throughout their whole course. Some of the mesenteric glands were enlarged and hemorrhagic.

The right kidney, weight three and one-half pounds, was very pale, and the pelvis contained a small amount of thick yellow pus. The great mesenteric artery at the point of division from the abdominal aorta did not contain a clot, and no worms were found.

Two days before death, there was a large œdematous patch over the belly. This had entirely disappeared the day before death, and no fluid was found here at autopsy.

Direct coverslip preparations, tissues for histological examination and cultures were collected from the usual sources in the ordinary manner.

B. equisepticus was present in the cultures from the spleen and liver, streptococci in those from the heart's blood, staphylococci in those from the spleen, and an unidentified bacillus in those from the lung.

Case 38.—Feb. 7, 1903, Drs. Ward, Brimhall and Wesbrook visited Mr. H.'s farm and made an autopsy on Case 38. The animal was a Clydesdale gelding, bay, two years old last spring. Sex, male. From Dr. Ward was obtained some idea of the clinical features of the case, as observed by him. A week before the visit the temperature ran 104.5°; pulse, 55; respiration, normal. The staggering gait was very apparent; polyuria was a marked symptom; appetite had been poor; horse was described by Dr. Ward, as moping and dump-

ish. Considerable swelling was noticed in the hind legs; medium degree of emaciation. Mucous membrane pale.

The horse had died during the night of Feb. 6th, and was left in the stall, in the stable. At 10 a. m., Feb. 7th, he was dragged out in the open in the shelter of an old building used for housing pigs. Here the autopsy was performed. Snow covered the ground, and the weather was very cold.

Autopsy.—The chest wall was infiltrated with a clear yellowish serum, which extended from below the skin in the connective tissue between the muscles, most marked on the left side. Large hemorrhagic areas were present in the subcutaneous tissues over the left thorax. No abscesses were found. The hind legs, which had been swollen during life, were reduced in size. The left hock contained a clear yellowish synovial fluid, not abnormal in amount, and somewhat gelatinous in consistency. Seemed normal.

Thorax.—In the anterior mediastinum, was found one large hemorrhagic lymph gland.

Pleura seemed normal. No excess of fluid.

Lungs. The left lung was œdematous and showed two or three small dark areas, somewhat depressed. The right lung was pale, not œdematous; did not collapse when the chest was opened. There may have been an accumulation in the bronchi or trachea, which occurred just before death.

Pericardium contained about 300 c. c. clear amber colored fluid.

Heart wall pale throughout. No marked infiltration of the auriculo-ventricular groove, although there were small punctiform hemorrhages.

Diaphragm.—Normal.

Abdomen.—Spleen enlarged, very friable, full of blood. A few hemorrhages shown in the pale gray capsule.

Liver. Irregularly bile stained. Very full of blood and friable. The lobular markings showed well through the capsule.

Kidneys. Very pale. Small punctiform hemorrhages showing through the capsule, gave appearance of "turkey egg." Macroscopically, kidneys showed parenchymatous nephritis in cut sections.

Bladder empty.

The mesenteric artery contained a thrombus, showing the presence of a few strongyli. The peritoneal surface of the whole bowel, and the mesentery also, was stippled with small, bright hemorrhagic areas, ranging from the size of those just visible to 0.5 mm. The stomach contained a small quantity of bots and the large colon contained many of the large mature strongyli.

Direct coverslip preparations, tissues for histological examination and cultures were collected from the usual sources in the ordinary manner.

B. equisepticus was isolated from the cultures from the joint fluid, jugular blood and spleen. *B. coli communis* was present in the cultures from the heart's blood, jugular blood and kidney. Streptococci were present in cultures from the heart's blood, jugular blood and kidney. An unidentified bacillus was present in the cultures from the lung, and another in the cultures from the kidney.

Outbreak XVII.

Case 35, *Birkholz, Polk Co.*—Jan. 2, 1903, Dr. J. G. Annand brought to the laboratory in a Mason's jar, specimens removed at autopsy from a horse which had been killed for the purpose. The horse was the property of O. O., Birkholz, Heyden Twp., Polk Co., Minn., who lost six horses from "swamp fever." The animal had been sick since last summer. When seen by Dr. Davidson, of Grand Forks, two weeks ago, the animal seemed to be recovering, but on Dr. Annand's visit, December 30th, it was down, and extremely weak, though still eating everything he could reach. The animal was killed by shooting, and a post-mortem made at once.

On opening the chest, the mediastinal surfaces of both lungs were found covered with hemorrhagic areas. The surface of the liver contained a great many masses of fiber. The spleen was apparently normal. The cortex of the right kidney, showed some small hemorrhagic petechiæ. A tumor, apparently fatty, was present at the upper extremity of the ureter. A large aneurism was present on the middle mesenteric artery. There were no abscesses.

Portions of the lung, heart, spleen, liver, kidney, and the aneurism from the mesenteric artery were brought to the laboratory (a worm had been observed in this aneurism when opened in the field by Dr. Annand).

Cultures were made in broth and on serum from the heart, lung, spleen, liver and kidney. After 24 hours in the incubator, no growth was present on those from the heart and lung. Cultures from the spleen showed a small, diplococcoid belted bacillus which subsequent cultures showed to be *B. equisepticus*. In addition, there was present, a long, thick, spore-bearing motile bacillus of a bright yellow growth on agar. Cultures from the liver showed only *B. equisepticus*. Cultures from the kidney showed a large diplococcus.

Outbreak XVIII.

Case 36, *Birkholz, Polk Co.*—Jan. 1, 1903, there was received in the laboratory from Dr. J. G. Annand, in a quart Mason's jar, speci-

mens removed at autopsy from a horse which had been killed for the purpose. Animal was the property of Mr. John D., resident of Sandville Twp., Polk County. The horse had been sick six months. On Dr. Annand's visit December 30th, he was found to be thin in flesh, much debilitated, but able to move around; was killed by shooting and an autopsy made at once.

A marked hemorrhagic area was found in the superficial muscular tissue of the superior lumbar region. The mediastinal surfaces of both lungs showed hemorrhagic areas. The heart showed no lesions. The spleen showed large and small hemorrhagic areas on its surface. The surface of the liver was covered with fibrin. The kidneys both showed small hemorrhagic areas in the cortex. The artery supplying the large colon contained a small aneurism, which was extremely hard. Another aneurism was present in the mesenteric artery supplying the upper portion of the small intestine.

Specimens had been kept cold, just above freezing point, from the time of their removal, until brought to the laboratory. They were then placed out-of-doors in a temperature of about 20° F. above zero, and on the following morning were found slightly frozen.

Cultures were made from the lung, heart, spleen liver. Those from the lung after 24 hours in the incubator, showed a large diplococcus, and a small diplococcoid belted bacillus, which subsequent cultures showed to be *B. equisepticus*. Those from the heart wall showed no growth. Those from the spleen showed a small diplococcoid belted bacillus which subsequent culture showed to be *B. equisepticus*. Those from the liver gave a short thick oval spore-bearing, non-motile bacillus, having a wrinkled growth on agar, and a large, long, thick, motile bacillus, non-spore-bearing, having a wrinkled growth on agar.

It would appear from the cultures that the only significant bacteria present were *B. equisepticus*, from the lung and spleen—with the possible exception of the diplococcus from the lung— the large bacilli from the liver being probably contaminations.

GENERAL DESCRIPTION OF "SWAMP FEVER" AS OBSERVED IN CASES INVESTIGATED BY THE MINNESOTA STATE BOARD OF HEALTH.

As will be seen from the foregoing detailed statements concerning investigations, a large number of cases of this disease have been seen since the autumn of 1901.

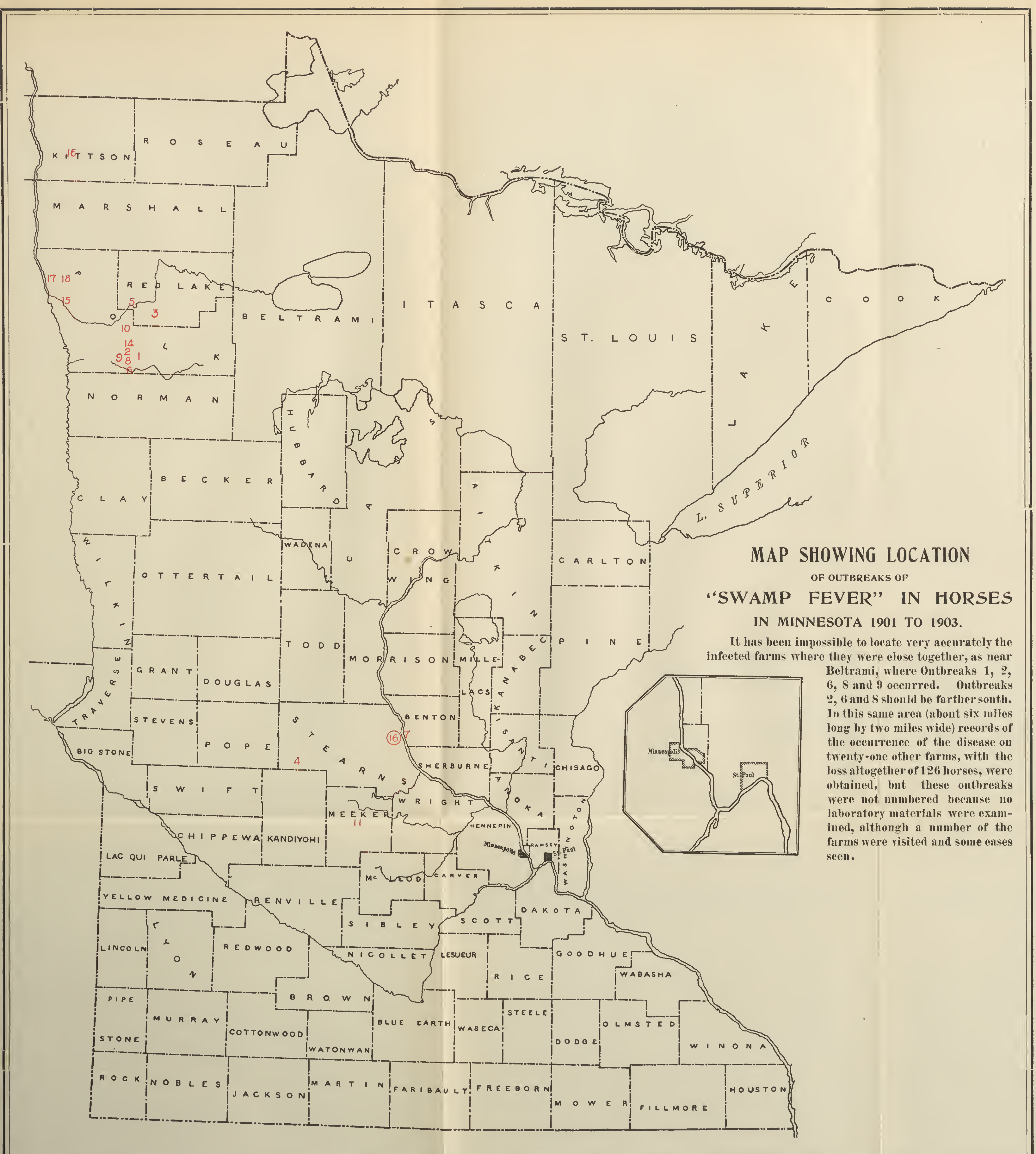
The distribution of these cases may be ascertained from the accompanying map, which shows what may be termed two foci of

infection, one in the valleys of the Red and Red Lake rivers, and the other in an area included in Stearns, Meeker and Benton counties.

Whether cases have occurred, to any marked degree, in other localities in the state cannot be definitely stated. From all the information which could be obtained from owners of stock, veterinarians and other interested observers, it would appear that in the northern focus cases have been noted by different individuals for from 2 to 18 or 20 years. The owner of cases Nos. 34, 37 and 38, Outbreak No. XVI., formerly lived near Hallock, Kittson county, which is not far from the Manitoba border line. He believes that he has been losing cases from this disease for the past 14 or 15 years. He moved to the middle portion of the state near St. Cloud in 1902, and the three cases, Nos. 34, 37 and 38, reported in these investigations, were apparently suffering from the disease before he brought them south, so that they cannot be rightly considered in relationship to the southern focus. Dr. Longevin, V. S., of Crookston, Minn., states that he has had cases, which do not differ materially from certain of those studied during this investigation, under his observation for the past 20 years. Many of the stock owners in the vicinity of Beltrami report their losses from this disease as extending over a period of from 2 to 10 years.

In the southern focus of infection it has been impossible to obtain an accurate history which would indicate that this disease has been long recognized.

1. **Local Conditions in Relation to Outbreaks.**—In the northern focus of infection the conditions obtaining on the individual farms are fairly comparable. The soil is a heavy black loam, of the lacustrian formation characteristic of the banks of the Red River and its tributaries. The country is markedly flat, and there is little natural drainage. Where flowing wells are present, the land in their vicinity is frequently boggy, owing to the impossibility of drainage, as the drains frequently freeze solid in the winter, and in the early spring there are vast quantities of ice which, when melted, result in the formation of small lakes or ponds in the neighborhood of the stables. Wherever there is a slight dip in the land, water stands for a large portion of the year and swamp hay grows in abundance. There are certain minor exceptions to this general condition in a few of the farms. The farm on which Outbreak II. occurred consists for the most part of this typical loam, being very flat. Across the southeast corner, however, the Sand River flows,



MAP SHOWING LOCATION
OF OUTBREAKS OF
"SWAMP FEVER" IN HORSES
IN MINNESOTA 1901 TO 1903.

It has been impossible to locate very accurately the infected farms where they were close together, as near Beltrami, where Outbreaks 1, 2, 6, 8 and 9 occurred. Outbreaks 2, 6 and 8 should be farther south. In this same area (about six miles long by two miles wide) records of the occurrence of the disease on twenty-one other farms, with the loss altogether of 126 horses, were obtained, but these outbreaks were not numbered because no laboratory materials were examined, although a number of the farms were visited and some cases seen.

and there is a well marked gravel and sand ridge. One farm* on which from June, 1901, to May, 1903, 10 horses had succumbed to the disease, was five miles north of Fisher, Minn. This farm occupies ground which was apparently an island when the surrounding country was covered with water. The ground is rolling and covered with large trees in marked contrast to most of the Red River Valley. It is well drained. The soil is a rich black loam, similar to that of the remainder of the Red River Valley.

The southern focus of infection does not cover a solid block of territory, as is the case in the northern focus. In fact, this disease has been observed only in three localities near St. Cloud, Litchfield and Belgrade. There is nothing to show that this triangular territory, of which the three localities named are the angles, is generally infected, as is the case in the northern focus. Near St. Cloud (Outbreak VII.) the country is rolling, with an exceptionally light, sandy soil, in many place well wooded. In certain districts granite underlies the sand. On the farm on which Outbreak VII. occurred the buildings were situated on a sandy hill, and there was only one small swampy pasture on the farm.

Near Litchfield there is very light sandy soil. It is very rolling, and on the farm where Outbreak XI. occurred, there were alternating steep hills and valleys, some of the latter containing water. Dr. Peters, V. S., believes that in this vicinity 50 or 60 cases of swamp fever have occurred during the last 10 years.

In the vicinity of Belgrade the land is low-lying and swampy. A large portion of it is covered with scrub oak and alders, interspersed here and there with tamarac. On the farm in which Outbreak IV. occurred there was one swamp which covered several acres.

It will be seen that in both the northern and southern foci feeding from low-lying ground or the use of coarse hay cut from low places cannot be excluded, although observations have not tended thus far to show conclusively the relationship between this and the disease.

The source of the water supply varied considerably, that in the northern focus being derived frequently from flowing wells or from surface wells sunk some distance through the black loam and clay. In certain of the farms of the southern territory the wells have been sunk through sand. The possibility of horses in pasture ob-

*Although the disease on this farm was studied, since no laboratory material was collected, the outbreak was not numbered and catalogued with the others.

taining the water from pools, marshes or lakes cannot be excluded. Suspicion attached in many of the outbreaks to the water and feed, and the owners of affected stock were always desirous of having these thoroughly investigated.

The housing of horses was fairly good in most cases, and exceptionally good in many. Certain of the horse stables, however, particularly in the northern focus, were without floors, and at certain seasons of the year, therefore, decidedly damp, the mixture of manure and black loam tending to retain moisture for a long time. Certain of the stables are constructed of logs. The animals in most cases were more likely to suffer from heat in the summer than from cold in the winter.

2. **Season.**—It is felt that insufficient data is at present at hand to make any definite statement in relation to the time of year when infection takes place, although it would appear that the first symptoms were observed by owners of stock during the summer months. The cases seemed to begin in the early summer months, and to increase in number during the months of July and August, after which relatively few were noticed to develop. A few cases have been reported and also examined during the winter months, but in these the history given showed that the animal had been suffering from the disease since the preceding summer. These observations coincide with those in the Manitoba cases. The observations in this state and Manitoba, however, do not tend to show conclusively the time at which infection takes place, since the disease is usually insidious in its onset, and sometimes assumes a very chronic type. If it be true that infection takes place during the summer months, the possible relationship of insects or arachnids to the spread of the disease must be considered along with temperature, etc., as a factor in aiding saprophytic development of parasitic bacteria. It is at this season of the year when horses are likely to be overworked, and when there is a greater variation in the food supply than during the winter, both of which factors may have some effect on their resistance to infection. The relationship of season, if found to be constant, may have some other explanation than can be afforded by any of the suggestions hitherto advanced. A parasitic theory was and is still tempting, but the results of the Manitoba investigations and the earlier examinations in the work of this board, which seemed to exclude blood parasites, together with the positive demonstration in practically all cases in which a satisfactory examination was possible, of *B. equisepticus*, and in

Barn of Mr. M., who lives three miles southwest of Beltrami, and who reports the loss of six horses from "swamp fever." No material was collected for laboratory study.

certain instances of *B. pyrogenes equinus*, served to direct attention away from animal parasites to a bacterial cause. Why horses should be more susceptible to *B. equisepticus* or other micro-organisms during the summer months is not easy of explanation, unless temperature and other conditions tend towards their more abundant saprophytic development, are less destructive of the life of the organism, or that the horses themselves are rendered by the nature and variety of the summer feed, possible overwork and the high temperature of their environment, less resistant to infection.

3. **Onset and Course of Disease and Mortality.**—From the observations in Minnesota, as well as those reported in Manitoba, it would appear that this disease is, as a rule, rather insidious in its onset. Frequently a history is given, which shows that the affected animal has been "out of sorts" for some weeks. Sometimes for a day or two the horse may have refused food, though this is not constant. A general weakness, very gradual in development, loss of flesh, periods of fever, followed by times of apyrexia, gradual emaciation, staring coat, a ravenous appetite, and in some instances polyuria, constitute the train of symptoms. In Minnesota a rather common history, however, is that the owner of the animal has noticed very little wrong, and may have been working him all the time, although he has noticed gradual loss of condition with periods of apathy. These periods of apathy bear some relationship to the occurrence of the fever, i. e., as noticed by the owner they probably correspond to the periods of apyrexia. In one instance a horse, apparently in the beginning of the disease, working on a binder, was found to have a temperature of 105° F.

The duration of the disease varies. In some instances symptoms are noted by the owner only for a period of from one to four weeks before the death of the animal. This is apparently the exception in Minnesota, although in the horses seen during this investigation it was met with frequently. The owners of horses are inclined to dwell upon the chronicity of the disease, and to believe that they may apparently recover and some months later succumb.

Certain of the cases seen,—particularly Cases 11 and 12, Outbreak VI.—were sick only from one to two weeks, according to the observations of the owner, whereas others (Cases 13 and 25, Outbreak VII., Cases 34, 37 and 38, Outbreak XVI.) had been observed to be suffering from the disease for several months.

In those cases in which symptoms have been observed for only a few days, it is perhaps unsafe to assume that infection occurred

immediately before the first symptoms were observed, unless the observations have been made by a competent veterinarian.

In the endeavor to ascertain the mortality of the disease in this state, circulars were sent out to all the owners who were known to this board to have lost heavily from the disease. From these circulars, and from information collected from time to time, it has been found impossible to state definitely what the mortality is, since the diagnosis of many cases must remain in doubt, where information was received through horse owners and not through veterinarians.

In the neighborhood of Beltrami, over a section about two miles wide by six miles long, 26 farmers have reported the loss of 136 horses from this disease. From 12 other owners of horses the loss of 75 animals from swamp fever has been reported, which makes a total of 211 animals lost from this disease on 38 farms. From the experience at Beltrami, which neighborhood was more thoroughly studied than any other, it would seem that close investigation in other localities would reveal a similar condition of affairs. From all available data the mortality in Minnesota would appear to be in the neighborhood of 80 per cent.

Many of the owners who have lost heavily from this disease believe that a horse once affected will never recover, and where animals have apparently regained their normal condition, they are afraid to put them to hard work again.

4. **Age, Sex, Character of Animals Affected.**—From the details which have been given concerning the outbreaks, as also from the table of symptoms which is given under the following paragraph, it will be seen that horses of all ages and both sexes are affected by this disease. Farm horses, driving horses and colts running at large have all been found infected. Well bred horses from eastern stock, those brought from other localities and those raised on the infected farms have all succumbed to the disease. By some stock owners bronchos were thought to be immune, but this does not appear to be the case. No cases have been observed in mules or asses.

5. **Symptoms.**—The occurrence of so many cases of this disease in somewhat inaccessible portions of the state rendered continuous clinical observations by the veterinarians of this board impossible. In the earlier cases studied it was hoped that the establishment of a branch laboratory in the infected district near Beltrami would be possible, and that cases could be kept under daily observation

TABLE I.—SHOWING SYMPTOMS OBSERVED IN "SWAMP-FEVER" CASES.

Outbreak No.	Case No.	Locality	Swamp Food Used	Farm on High Ground	Positive Diagnosis of Swamp-fever	Age	Sex	Date	How Long Sick	Temperature	Pulse	Respiration	Red Blood Cells	Haemoglobin	Leucocytes	Abscesses	Oedema	"Wobbling" Gait	Ulcers on Mucous Membrane of Mouth	Emaciation	Polyuria	Hemorrhages	Voracious Appetite	Marked Sweating	Marked Coagulability of Blood	REMARKS.
II	2	Beltrami	+	—	+	Colt	M	Nov. 16, 1901	6 weeks	...	...	...	5,420,000 A	...	...	+	+	+	...	+	...	+	...	...	...	Killed for autopsy November 16, 1901.
II	3	Beltrami	+	—	?	Colt	...	Nov. 16, 1901	2 mo's. Recovering	...	...	...	4,839,000 (?)	...	...	...	...	...	...	...	...	+	...	...	...	Died later of disease.
III	6	Red Lake Falls	—	+	+	...	F	Nov. 18, 1901	1 week	...	...	...	9,998,000 (?)	...	...	...	...	...	...	...	...	...	...	...	...	Killed for autopsy November 18, 1901.
IV	7	Belgrade	+	—	+	4	M	Nov. 23, 1901	...	...	...	...	...	...	...	...	...	...	...	...	...	+	...	...	...	Killed for autopsy November 23, 1901.
V	8	Wylie	+	—	+	10	F	Jan. 20, 1902	6 mo's	101	46	...	...	...	...	+	+	+	...	+	+(?)	+	+	+	+	Killed for autopsy January 20, 1902.
II	9	Beltrami	+	—	+	2+	F	July 24, 1902	3 weeks	103.5	80	...	lost	60	lost	+	+	+	...	+	...	+	+	...	+	Killed for autopsy July 24, 1902.
II	10	Beltrami	+	—	+	2+	F	July 24, 1902	2+ weeks	102.5	...	...	2,268,000 V	55	422,000 (?)	+	+	+	...	...	...	...	...	...	...	
								Aug. 19, 1902	6 weeks	103	90	38	1,252,000 V	40	12,000	+	+	+	+	+	...	+	+	...	+	Killed for autopsy August 19, 1902.
VI	11	Beltrami	+	—	+	Aged	M	Aug. 1, 1902	1+ week ?	103	...	labored	4,224,000 V	70	57,000	+	+	+	...	+	...	+	?	...	+	Killed for autopsy August 1, 1902.
VI	12	Beltrami	+	—	+	...	F	Aug. 1, 1902	3 weeks	102.5	...	labored	3,400,000 V	60	33,000	...	+	+	...	+	...	...	+	...	+	Died 1 week later.
VII	13	Sauk Rapids	?	+	+	14	M	Sept. 1, 1902	1 year	...	...	...	...	...	...	...	+	+	...	+	+	+	+	...	+	Dead on arrival. Farm on high sandy ground. One marshy pasture.
VI	14	Beltrami	+	—	+	10	M	Aug. 19, 1902	5 days	102.2	60	26	2,484,000 V	70	9,000	+	+	+	+	+	+	...	+	...	+	
								Aug. 26, 1902	12 days	98.8	48	22	4,224,000 A	60	60,000	+	+	...	+	+	+	+	+	...	+	Killed for autopsy August 26, 1902.
VI	15	Beltrami	+	—	+	5	F	Aug. 19, 1902	5 days	102	66	17	7,264,000 V	80	14,000	+	...	?	+	?	+	...	*	...	+	
								Aug. 26, 1902	12 days	104.2	64	20	...	70	...	+	+	+	+	some	...	+	+	...	+	
								Sept. 7, 1902	24 days	104	68	40	...	60	...	+	+	+	+	+	...	+	+	...	+	Killed for autopsy September 7, 1902.
VI	16	Beltrami	+	—	(?)	Aged	M	Sept. 7, 1902	10 days	100	46	18	...	pale m.m.	...	...	+	?	...	+	...	...	+	...	...	Recovered. (?)
VI	17	Beltrami	+	—	(?)	...	M	Sept. 7, 1902	...	101.2	44	48	...	pale m.m.	...	...	...	+		...	...	...	+	...	...	Recovered. (?)
II	18	Beltrami	+	—	+	4 yrs.	F	Aug. 19, 1902	1 year. Recovered	...	...	...	...	pale m.m.	...	...	+	+	...	...	...	...	+	...	...	Recovered. (?)
VIII	19	Beltrami	+	—	+	19 yrs.	M	Aug. 26, 1902	5 days ?	102.6	60	20	1,812,000 V	40	47,000	+	+	+	+	+	+	+	+	...	+	Killed for autopsy August 26, 1902.
VIII	20	Beltrami	+	—	(+)	6	M	Aug. 26, 1902	4 days ?	102	68	...	5,564,000 V	80	48,000	...	...	...	...	...	+?	...	...	...	...	
								Sept. 7, 1902	Recovering	101.2	56	20	...	...	...	...	...	...	...	...	...	...	...	...	...	Died January 12, 1903. Autopsy held.
VIII	21	Beltrami	+	—	(?)	10	M	Aug. 26, 1902	10 days	105	70	35	4,574,000 V	65	51,000	...	...	...	+	+	...	...	...	...	...	Recovered. (?)
								Sept. 7, 1902	22 days	100.2	48	16	...	m.m. imp.	...	...	...	...	gone	...	...	...	...	...	...	
VIII	22	Beltrami	+	—	(?)	10	M	Aug. 26, 1902	9 days	103.5	62	...	...	70	...	...	...	...	+	...	...	...	+	...	...	
								Sept. 7, 1902	19 days	100.2	48	18	...	...	...	...	...	...	...	...	+	...	...	...	...	Recovered. (?)
IX	23	Beltrami	+	—	(+)	10	F	Sept. 8, 1902	...	...	58	22	2,352,000	65	7,000	...	+	+?		?	...	...	+	...	...	
VI	24	Beltrami	+	—	(?)	8	F	Sept. 7, 1902	20 days (?)	103.6	44	38	...	m.m. pale	...	...	+	+?		+	...	...	+	...	...	
VII	25	Sauk Rapids	+	+	+	7	F	Sept. 12, 1902	1 year	101.4	55	14	...	50	...	...	+	+	...	+	+	...	+	...	...	Died October 2, 1902. Farm on high sandy ground. One marshy pasture.
X	26	Crookston	+	—	+	5	M	Oct. 1, 1902	5 weeks	97.2	84	...	798,000	20	5,000	...	+	+	...	...	...	+	...	...	—	Killed for autopsy October 1, 1902.
XI	27	Litchfield	+	—	+	9	F	Oct. 3, 1902	6 weeks	103.7	80	...	...	35	...	...	+	...	...	...	...	...	...	...	...	Farm on sandy rolling ground with marshes and ponds. Horse killed for autopsy October 3, 1902.
XII	28	Portage La Prairie, Man.	+	—	+	10	M	Oct. 18, 1902	2 mo's. Recovered	...	60	16	6,400,000 V	70	...	...		+	...		...	...	...	...	...	Had almost completely recovered. Killed for autopsy October 18, 1902.
XIII	29	Winnipeg, Manitoba	+	—	+	6	F	Oct. 20, 1902	2 mo's. Recovering	100	48	...	5,683,000 V	70	...	...	...	...	...	...	...	...	...	...	...	Had almost completely recovered.
XIV	30	Russia	—	+	+	10	F	Oct. 23, 1902	12 weeks	102	52	...	...	50	...	+	+	...	...	...	...	...	...	...	...	Later history unknown.
XIV	31	Russia	—	+	+	10	F	Oct. 23, 1902	10 weeks	102.6	76	...	5,420,000	...	...	...	+	+	...	+	...	+	+	...	...	Killed for autopsy October 23, 1902.
XV	32	Fisher	—	+	+	10	M	Oct. 30, 1902	7 days	104	72	...	...	...	...	...	...	+	...	+	...	...	+	...	...	Later history unknown.
XV	33	Fisher	—	+	+	2 yrs.	?	Oct. 30, 1902	6 weeks	103	70	...	5,800,000	40	3,600	...	+	+	...	+	...	+	+	...	...	Later history unknown.
XVI	34	St. Cloud	See Remarks		+	5	F	Nov. 22, 1902	7 mo's	102.4 104.5	96	...	...	45	...	...	+	+	...	+	...	+	...	...	...	Had contracted the disease in the Red River Valley before coming south. Killed for autopsy November 22, 1902.
XVII	35	Birkholz	+	—	+	...	...	Dec. 30, 1902	6 mo's	...	...	...	...	...	...	—	...	...	...	+	...	+	+	...	...	Killed for autopsy December 30, 1902.
XVIII	36	Birkholz	+	—	+	...	...	Dec. 30, 1902	6 mo's	...	...	...	...	...	...	...	...	...	...	+	...	+	...	...	...	Killed for autopsy December 30, 1902.
XVI	37	St. Cloud	See Remarks for case 16		+	4	M	Feb. 5, 1903	...	101.4 to 103.2	70 to 90	...	1,414,000 to 1,588,000	30	3,000 to 4,000	—	+	+	—	+	+	+	+	...	—	Horse shipped to laboratory February 5, 1903. Died and autopsy performed Feb. 11, 1903.
XVI	38	St. Cloud	See Remarks for case 16		+	2½	M	Prior to Feb. 7, 1903	...	104.5	55	normal	...	...	...	—	+	+	...	+	+	+	—	...	...	Clinical observations by Dr. S. H. Ward. Animal dead on arrival February 7, 1903. Autopsy held.

A. Indicates that blood was obtained from artery. V. From vein. * At first lost.

for several weeks. This was found impracticable, owing to the amount of bacteriological work involved in the examination of specimens collected at autopsy. The working out of these kept the whole laboratory force employed, since the material brought in from one autopsy frequently required several days or even weeks for its satisfactory classification and initial study.

As has been stated before, it had been planned to bring infected cases to the Laboratory of Animal Research, where they might be kept under daily observation, but for the reasons already given this was found impossible, except in Case No. 37, which died five days after arrival.

The following table gives some idea of the symptoms observed in the different outbreaks, as well as certain data concerning local conditions, duration of disease, age, sex, etc., to which reference has been made already.

One of the most marked symptoms of this disease is the *gradual loss of condition.* The hair becomes staring, and gradual emaciation develops. In a few cases the appetite was noted to diminish with the onset of symptoms, but in most instances this was not noticed. Loss of condition, extreme emaciation and progressive weakness in the limbs was all the more remarkable in consideration of the voracious appetite usually noted. The appetite usually continued, irrespective of the quality of the food, and whether the horse was working or not. An illustration of it is afforded by Case 10, Outbreak II., in which this colt reached out to nibble at the grass and weeds as it was being dragged away on a "stone boat" to be killed for autopsy, it being too weak to walk. As the disease progresses a staggering or "wobbling" gait is noted. This is particularly apparent in the hind legs when the horse is turned short. This symptom persists, and in cases which are apparently recovering may be noted for a long time. In a number of the animals examined thrombi in the iliac arteries were observed, although it would not appear that this condition was responsible for the gait. Where the horse had been suffering from the disease for several weeks, swelling of the legs was noticed, and in many of the cases the joint fluids were increased and a marked tenderness over the joints observed. In one animal, Case 19, Outbreak VIII., there was a very marked puffiness and œdema of the left shoulder joint, and at autopsy a small abscess of the tendon sheath with erosin of the bicipital groove was found. Patches of œdema developed on the thorax and abdomen of the horses, particularly in the last stages

of the disease. In fact, the œdematous areas developed very frequently in the most dependent portions, and were encountered in horses which had been unable to rise for any considerable time. In certain instances areas which had been at one time œdematous, were later found to be purulent. (See Case 15, Outbreak VI.)

The occurrence of abscesses was not at all constant. Their presence was noticed in Outbreaks II., V., VI., VIII. and XIII. They varied considerably in size. In certain of the animals seen during this investigation, sweating appeared to be very marked, although not necessarily uniform over the whole surface of the body. (See Case 8, Outbreak V.)

Polyuria.—Polyuria in many cases had been observed by the owners, and was particularly marked in Case 14, Outbreak VI.; Case 13, Outbreak VII.; and Case 26, Outbreak X. In case 14, Outbreak VI., the animal urinated four or five times in two hours.

Satisfactory chemical and microscopic examination of the urine was impossible, owing to the distance of the infected localities from the laboratory and the changes which took place during transportation. (See Cases 14 and 15, Outbreak VI., and Case 19, Outbreak VIII.)

Albumin was found scanty or absent. No red blood cells, pus or casts were seen.

Respiration.—The respiration was increased in frequency, especially upon exertion, and when there was great weakness. Many of the observations were made just prior to the killing of the animals for autopsy, and no very definite statement therefore can be made concerning respiration, temperature or pulse, since these cases were so far advanced.

Temperature.—The temperature varied, and there appeared to be periods when fever lasted for several days, followed by periods of apyrexia. In the investigations by this board the temperature varied between 100.2° and 105° F. In Manitoba the temperature is reported as "variable, running high for a few days, then falling almost to normal for several days, then rising again, but towards the latter stage of fatal cases remaining persistently high." A definite *periodicity* of the fever comparable with malaria has not been noted. During the febrile attacks the animals frequently seemed to be quite spirited, and the owners thought they were recovering. In the apyrexic periods they were listless and depressed.

Pulse.—The pulse was increased in frequency as a rule, particularly when weakness was marked or the temperature high.

Dr. Torrance calls attention to "the particular thrill as if the blood vessels were only partially filled," in his observations on the disease in Manitoba, in which an especially good account of the symptoms and course of the disease is given.

Anæmia.—The mucous membranes of the mouth and eye soon develop a pallor which in advanced cases becomes extreme. Hemorrhages have been noted, but rarely on exposed mucous membranes. In several cases ulcers were found on the tongue or lip, but there is nothing to show that these served as the original foci of infection. The blood is usually pale in color, even to the naked eye, and undergoes coagulation rapidly, except in very advanced cases. The hæmoglobin, as determined by Tallquist's method, varies from 20 to 80 per cent. In some of the acute cases the low percentage of hæmoglobin was not very apparent (Case 15, Outbreak VI.). In Case 11, Outbreak VI., where the sickness of the animal had been noticed only one week, the hæmoglobin percentage was 70.

The blood, when smeared on coverslips, quickly separated so as to show alternating red and light colored areas. This seemed somewhat characteristic.

The number of red blood cells was found to vary within rather wide limits, the lowest counts being in the neighborhood of 1,000,000 per c. mm. With the progress of the disease there was a very great decrease in the red blood cells, accompanid by a loss in the hæmoglobin percentage. The leucocyte count was found to be variable, ranging from 3,600 to 60,000. In most instances where the leucocytes were present in great number, there were localized collections of pus, although this relationship was not shown to be constant. In connection with the red blood cell and leucocyte count, it should be mentioned that blood was mixed with Toisson's solution and the filled pipette taken to the laboratory for examination, so that in some instances 24 to 48 hours elapsed between the collection of the specimen and the count. In Case 37, Outbreak XVI., and Case 29, Outbreak XIII., the counts were made immediately.

6. **Morbid Anatomy and Pathology.**—In these investigations a thorough study of the morbid anatomy (including) histology of the disease had been planned. The positive bacteriological results obtained in the early cases involved an amount of laboratory work scarcely credible. On account of the necessity for the collection of material in the field and the advanced stages of associated con-

ditions, such as abscesses, etc., a very great deal of work in the isolation and identification of a multitude of bacteria was necessary. Thorough and satisfactory work was somewhat impeded by the fact that during July, August and September, 1902, owing to the interest aroused and the large number of cases reported, it became necessary to perform a great number of autopsies and to work out the bacteriology within a very short time. The distances to be traveled were also great. As has been already stated, from all cases materials were collected from the sources noted and fixed for histological study. Some of these tissues have been worked up, but it is felt that insufficient data has been yielded as yet to warrant any attempt at detailed report or the drawing of conclusions.

The necessity for making a final report upon infectious diseases of animals at this time requires this board to make a report to date on "Swamp Fever," although anything in the nature of an exhaustive report had not been contemplated until completion of the work, including thorough pathological and experimental study. It is hoped that opportunity may be afforded in the future to work up all the pathological material now on hand, when a further report or paper may be expected.

A general idea of the pathological findings met with may perhaps be best obtained by first discussing the kinds of lesions and their location, with a later summary under the individual systems or organs.

The hair appeared staring and coarse. Emaciation was great, and some difficulty in the skinning of the animal was therefore experienced. The subcutaneous fat was very scanty, and usually had a marked yellow tint, suggesting jaundice. This peculiar yellow tint was characteristic of the fat found throughout the body, and in a number of instances the fluids met with in the serous cavities were of the same color. In many animals sharply outlined œdematus patches were present, underlying the skin in the dependent portions of the body, as described under symptoms. The most common sites were on the chest, extending back upon the abdomen (see Cases Nos. 12-25 and others), and were found in the subcutaneous tissue of the legs. In those cases in which the animals had been down for some time, the œdema often appeared upon the side on which they had rested (see Case No. 15). In some cases there was good evidence to show that such subcutataneous œdematous areas later became purulent (see Case No. 15 and experimental horse No. 4). Such œdematous areas, variable in extent and generally yellowish in color and gelatinous in con-

sistency, were met with between the chest muscles and those of the legs, and frequently surrounded abscesses when such were present. In the mediastinum they were also seen, and in the auriculo-ventricular groove on the ventral surface of the heart they were often found in advanced cases. In many instances, scattered throughout the gelatinous œdema or impinging on the border of it, hemorrhages varying in color (dirty yellow, bright red or almost black) were seen.

On removing the skin its lower layers, as also the subcutaneous connective tissue, showed in almost all cases hemorrhages varying in size from petechiæ to irregular spots two and three inches in diameter. These hemorrhages occurred not only in the skin and subcutaneous tissue, but between and into the muscles and fasciæ, the synovial sacs, in the lymph glands, in the mediastinum, upon the serous surfaces of the heart, lungs and peritoneum, sometimes involving the heart wall to such an extent that large red areas were visible under the pericardium, continued through the muscle and appeared under the endocardium.

The lung was sometimes stippled with red spots, showing through the pleura. At other times, irregular areas of hemorrhage occurred, which completely filled several contiguous lobules.

The spleen in a few instances seemed almost entirely devoid of hemorrhages, although, as a rule, it was found spotted with irregular red blotches, and in certain of the cases examined, well marked, extensive infarcts were to be seen.

The kidneys occasionally presented a "turkey egg" appearance, but in some cases large, well marked hemorrhages were seen beneath the capsule, and in some of the organs in which parenchymatous nephritis was well developed extensive microscopic hemorrhages were found between the straight and collecting tubules.

The mesenteric and intestinal wall, including stomach, quite frequently showed hemorrhagic areas, in some cases several inches in diameter. These were frequently sub-peritoneal, but in a number of instances involved the whole gut wall, including mucosa.

As has been stated, hemorrhages were sometimes found in the gelatinous œdema. Blood clots variable in color were found in abscesses, and occurred in inflammation and thickened tissues around the abscesses, as also around joints in which inflammation was well developed.

It is impossible to state accurately at what stage of the disease hemorrhages are most likely to occur, although it would appear

that they were more common in advanced cases when the blood changes were most marked.

As will have been seen from Table I., abscesses were quite frequently met with in those cases in which an autopsy was made. The occurrence of abscesses in the Manitoba cases would appear to be somewhat infrequent, and perhaps that is true also of those in Minnesota, although a somewhat different impression may be given from the records of this investigation. Abscesses were found in such sites as lymphatic glands, around and involving joints and tendon sheaths, patches of subcutaneous œdema which had later become purulent, and in some cases, particularly those examined in Outbreak II., the destruction of tissue was very widespread. In one animal, Case No. 9, a huge abscess, involving the hip joint, extended along the course of the iliac vessels, which were thrombosed, and presented beneath the peritoneum. Hemorrhages occurred in the wall of the abscess, and a yellow gelatinous œdema was found surrounding it in certain places, particularly in the tissue beneath the peritoneum and overlying the abscess, where it was over an inch deep. The pus usually was light in color and fluid, although in certain instances, owing to the presence of hemorrhages and clots, this appearance was not always observed. In one instance an abscess, the size of a small orange and well walled off with fibrous tissue, involved the apex of the spleen.

In some instances the lungs showed purulent areas.

Inflammation of the serous surfaces was so common as to be recorded as characteristic of this disease. Some one or more joints were found affected in nearly every animal. Excess of fluid with some thickening of the synovial sac was the least marked of these joint affections. Very often the fluid was found increased in amount and containing fibrinous flocculi, with roughening the inner joint surface, and in some instances blood clots were also seen. In few cases was a purulent synovitis seen, unless abscess formation involving the tissues around the joint was also present.

The pleural cavity usually showed some increase of fluid, and in a few cases the exudate was fibrinous. This was not common, however.

In the pericardium a similar condition of affairs was seen.

In the peritoneum well marked inflammation was quite frequently met with, and fibrinous flakes were often found upon the various abdominal viscera. In some cases the amount of fluid was enormous, and it was turbid with fibrinous flakes, so as to

be semi-purulent. In certain of these cases long thread-like worms, *filaria papillosa*, (*Rudolphi*), were found free in the peritoneal cavity.

Connective tissue replacement was observed in the areas which had been apparently occupied by pre-existing hemorrhages. These were especially noticeable in the heart of Case No: 8, where the organ was studded with fresh hemorrhages and retracted connective tissue patches, in some cases involving the whole thickness of the heart wall. This connective tissue development was also seen in those spleens in which infarcts had occurred, and was found in and surrounding the vessel walls where thrombosis had existed for some time. This latter has probably no connection, however, with this disease, as most of the thromboses met with were verminous in origin (*strongylus armatus*).

Blood.—Marked anæmia with diminution of red blood cells and lessened hæmoglobin percentage. Leucocyte counts variable, although usually increased over normal. Specific gravity and reaction of the blood undetermined.

Coagulability usually good, except in very advanced cases. The occurrence of chicken fat clots or coagulation peculiarities cannot be stated, since in most instances horses were killed by shooting or bleeding and the autopsy held immediately. Where blood was collected for cultural or other purposes it was usually found to coagulate very firmly and rapidly, even when a small quantity of blood was mixed with a large quantity of broth. In very anæmic subjects the occurrence of many hemorrhages, as noted above, was conspicuous.

Widal Reaction.—Upon the demonstration of *B. equisepticus* and *B. pyrogenes equinus* in the tissues and fluids of "swamp fever" horses a series of investigations was made to ascertain if the blood of such horses would cause "agglutination" of either one of these microörganisms.

For *B. equisepticus* negative results were obtained in all dilutions. With *B. pyrogenes equinus* agglutination and arrest of motion occurred even in high dilution, but as the blood of normal horses yielded somewhat similar results, no importance could be attached to the reaction.

Vascular System.—Heart enlarged. In many cases showing numerous hemorrhagic patches underneath the endocardium or epicardium, and occasionally involving the whole thickness of the heart wall. The pericardium frequently contained an increased

amount of fluid, and very occasionally showed sero-fibrinous pericarditis. Occasional hemorrhages in the costal pericardium. Heart muscle appeared dark in color, and in some instances where no macroscopic lesion was visible, red blood cells were to be seen between the seemingly normal muscle fibres. In some instances white, depressed areas, irregular in shape and size, were seen. These had probably been old hemorrhages or infarcts, and microscopically they showed replacement of the muscle by connective tissue. No changes in the vessels were noted which could be ascribed with certainty to this disease. In a number of instances firm coagula were found in the iliac vessels, evidently of some duration. These showed an alternation of red and white layers. In some instances these coagula were evidently related to abscess formation in the vicinity. In others, notably Case No. 8, both iliacs were obliterated by old coagula. The cœliac axis and the mesenteric vessels were frequently found plugged with coagula due to the presence of *strongylus armatus*.

The *spleen* in many instances did not seem to show marked change, although it was generally stippled with hemorrhages, showing through the capsule and sometimes markedly enlarged. Where peritonitis was marked, very often lymph flakes were seen covering its surface. The organ was found to be very rarely enlarged or soft, and well marked infarcts were not often seen. The consistency and general color were as a rule not markedly changed, except for the presence in most cases of the small hemorrhages already referred to. In one instance, as already stated, an abscess about two and one-half inches in diameter was found, involving the apex (Case 10). This was well walled off and separated from the remainder of the organ. This was the only instance in which an abscess was seen in this organ. The microscopic changes in the spleen cannot be reported here, since it is evident that much still remains to be done. The *bone marrow* has not yet been examined.

Lymphatic System.—The lymphatic glands are frequently swollen and infiltrated with a gelatinous exudate. In all cases it was possible to find certain lymph glands in which well marked hemorrhages could be demonstrated, and the whole gland was often found infiltrated with blood. The glands particularly affected were those in the axilla, groin, anterior mediastinum and certain mesenteric glands.

Respiratory System.—The pleura, both costal and parietal, frequently showed hemorrhages variable in number, size and shape.

Blood was never found free in the pleural cavity, although there was usually an excess of fluid. Sero fibrinous pleurisy was frequent but purulent pleurisy never seen, except where well marked superficial abscesses were present in the lungs. The lungs were frequently stippled in appearance or showed irregular somewhat depressed red areas ("swine plague lung"). These areas would seem to be due partially to hemorrhage and partially to collapse, and involved from one to several lobules, being visible. not only on the surface, but in sections of the lung. Pneumonia was not present as a rule except where lung abscesses were found. In one instance a long standing paralysis of the throat and the escape of food into the nose, produced a septic and gangrenous inflammation of the nasal passages. Emphysematous blebs and hemorrhages in the lungs were also present. (Case No. 11.) The spotted appearance of the lung indicated in some instances recent interstitial hemorrhage, and in others that the small amount of hemorrhage had set up lobular pneumonia and a partial collapse of the involved alveoli followed. Changes indicative of chronic irritation were not found. Bronchitis was never present in such manner as to suggest relationship to the disease.

Digestive Organs.—The stomach walls were frequently hemorrhagic, the hemorrhages being sub-peritoneal, sub-mucous, or in certain instances involving the whole thickness of the wall. This organ was usually found well filled with food, and with the exception of the hemorrhages and the results thereof, little, if any, change was observable. In the intestines there seemed to be no lesions demonstrable, except for the occurrence of hemorrhages similar to those noted in the stomach, and, in some instances, a marked inflammation of the peritoneal coat. Especial attention was not directed to the fauna of the intestinal tract, since this had been well studied by the Manitoba investigators.

The Liver.—This usually appeared increased in size and congested. In cases where peritonitis was marked, flakes of lymph covered its surface. The liver tissue was frequently softened, light in color and macroscopically and microscopically gave evidence of parenchymatous hepatitis. Branches of the portal vein were quite frequently found to contain whitish thrombi. Cirrhosis was present in at least two cases. Special study of the intestines and liver had been planned, but it was impossible to complete it for this report.

Genito-Urinary System.—The kidneys were usually markedly affected, showing evidence of parenchymatous nephritis. The cap-

sules stripped readily, the cortex was thickened and light in color, and the pyramidal portions very often beefy red. The occurrence of hemorrhages under the capsule has already been referred to. Microscopic examination showed evidence of tubular degeneration and marked hemorrhage between and into the straight and collecting tubules.

The following is a short synopsis of the appearance of the medullary portion of the left kidney of Case No. 8. Congestion of capillaries, apparent increase in leucocytes in the blood vessels, many small areas of hemorrhage, both in the connective tissue and into the tubules, infiltration, consisting of round cells with a few polymorphonuclear leucocytes in and about the areas of hemorrhage. Extensive degenerative changes were not found in the epithelium of the collecting and Henle's loop tubules. The cortex of the same kidney showed a chronic inflammation with thickening of Bowman's capsule and adhesions between the glomerular loops and capsule.

The Bladder.—This frequently showed hemorrhages in its wall, sometimes involving the whole thickness and the areas some inches in diameter. The urine was frequently excreted in vast quantities and at short intervals. In the pelvis of the kidney and bladder a residue of the color and consistency of yellow paint was found on more than one occasion. Chemical and microscopic examination of such sediment and of the urine was made in a number of instances (Cases Nos. 8-14-15-19), but insufficient data has been gathered to be included here, although it may be stated that albumin was found absent or in minimal quantities, casts, red blood cells and pus were never demonstrated, and the sediment seemed to consist of calcium carbonate with some larger quantities of calcium oxalate.

Miscellaneous.—The skin, subcutaneous lesions, affections of synovial membranes, œdema, hemorrhages and abscesses into and between muscles and fasciæ have all been given above.

The central nervous system was not investigated to any great extent, and nothing can therefore be said concerning its lesions further than the occurrence of hemorrhage into and œdema of the membranes.

7. **Bacteriology.**—Material was secured for bacteriological examination from the sources already mentioned under "Methods of Study" and shown in tabular form in Tables II. and III.

At autopsy the cultures were made with a view of determining whether bacteria were present in the living fluids and tissues, and

to ascertain if present, the localities to which they had been distributed and the channels through which the distribution had taken place. Pains were taken to guard against the bactericidal properties of the blood and tissues, and to employ enough material in the sowings to be reasonably certain that in the event of failure of development bacteria had been absent at the location from which the sowing had been made. In the living cases the sources from which cultures could be made were limited in number and consisted of blood, œdematous and synovial fluid, and in certain cases urine. In the first cases investigated at autopsy, micro-organisms were found, which seemed to belong to the hemorrhagic septicæmia group, i. e., of the same class as *B. bovisepticus* of hemorrhagic septicæmia in cattle and wild animals, such as buffalo, etc., *B. suisepticus* or swine plague bacillus, *B. choleræ gallinarum* of chicken cholera and the group of "ovoid bacilli," causing those diseases grouped under "Pasteurellose," by Trevison. This bacillus was uniformly found during the investigation of cases of "swamp fever" by this board, and is fully described below as *B. equisepticus*.

During the summer of 1902, on two farms (Outbreaks II. and VI.), from a number of horses killed for autopsy (Cases Nos. 9-10-11-14-15), and one horse examined whilst alive (Case No. 12), a bacillus with constant characteristics, which is later described as *B. pyrogenous equinus* was encountered. In a number of these animals its great abundance almost overshadowed the presence of *B. equisepticus*, and at that time caused considerable uncertainty as to the ætiology of the disease. Very careful examination of all cases investigated later served to exclude positively this micro-organism, as it was not encountered at all in those cases investigated subsequent to Sept. 7, 1902. Its relationsip, if any, to the disease, cannot be stated at this time. A positive demonstration of *B. equisepticus* in 17, and its probable presence in two other cases, 19 in all, would seem to show its ætiological importance in this disease, more especially in consideration of the experimental work, later given in this report. In only two cases (Nos. 26 and 28) in which autopsy has been made was it found impossible to demonstrate the presence of this micro-organism in the fluids or tissues. In Cases Nos. 7 and 8, micro-organisms morphologically resembling *B. equisepticus* were present in two or more localities, but through accident it was impossible to submit them to the final proof in order to establish their identity beyond question. In Case No. 26, owing to the difficulties under which the autopsy was held and the

admixture of so many contaminating micro-organisms, it is possible that *B. equisepticus* might have been present, although it was not isolated in purity. In Case No. 28 (Manitoba) micro-organisms were only obtained from three sources. The remaining eight sources from which cultures were made seemed to be sterile, as no micro-organisms developed. This case was one which the Manitoba authorities regarded as convalescent although not completely recovered.

It is thus evident that *B. equisepticus* was obtained practically from every case in which this disease was active, and in which a satisfactory autopsy was permitted. There is no evidence to show that it was absent from the tissues in Case No. 12, although not demonstrated. *B. equisepticus* was only found in the blood cultures made from two animals during life (see Table III.), and in the fluid from an enlarged gland at the angle of the jaw. (Cases Nos. 14 and 15). It would appear, therefore, that there may be times during which the micro-organism is not present in any considerable numbers in the circulating blood.

B. equisepticus would seem to be beyond doubt the same micro-organism as that obtained by Lignières from cases which he describes under the name of "typhoid fever in the horse." A few minor differences will be noted in the description of the micro-organism and its cultural peculiarities. Lignières' description of the disease studied by him differs very materially from "swamp fever" in symptoms, course and autopsy findings, although it has many points of resemblance. The following is a description of *B. equisepticus:*

Bacillus Equisepticus.—*Morphology,* as obtained from horses suffering from swamp fever is a small, non-motile, ovoidal bacillus. In direct coverslip preparations of the blood or tissues of animals it is from 0.6 to 0.8 microns in transverse diameter, and from 1.0 to 1.5 microns long. The size of this organism varies greatly. In blood or tissue preparations the bacilli are usually larger than those grown in or upon artificial media. There is considerable variation in size, even in the same culture. In hanging drop preparations the bacilli sometimes resemble pairs of minute diplococci, being analogous to the belted appearance seen in stained specimens. Occasionally several bacilli are noticed in chains, the individuals being so small as to resemble minute streptococci. In these investigations chains consisting of more than three bacilli, i. e., resembling a row of six cocci, have never been seen. In no

TABLE II.—SHOWING BACTERIOLOGICAL FINDINGS OBTAINED AT AUTOPSY ON "SWAMP-FEVER" HORSES.

CASE NUMBER.	2	7	8	9	10	11	12*	13	14	15	19	20	26	27	28	31	33	34	35	36	37	38
OUTBREAKS.	II	IV	V	II	II	VI	VI	VII	VI	VI	VIII	VIII	X	XI	XII	XIV	XV	XVI	XVII	XVIII	XVI	XVI
LOCALITY.	**Beltrami.**	**Belgrade.**	**Wylie.**	**Beltrami.**	**Beltrami.**	**Beltrami.**	**Beltrami.**	**Sauk Rapids**	**Beltrami.**	**Beltrami.**	**Beltrami.**	**Beltrami.**	**Crookston.**	**Litchfield.**	**Portage La Prairie.**	**Russia.**	**Fisher.**	**Hallock.†**	**Birkholz.**	**Birkholz.**	**Hallock.†**	**Hallock.†**
Oedema of			Chest *Unident. bac.*	Popliteal Region *B. coli comm.* *B. pyrogenes eq.* *B. equisepticus.*			Abdomen *B. pyro. eq.*	Over Sternum *B. subtilis.*		Jaw *Dipl. pneumoniæ (?)* *B. pyro. eq.* *B. equisepticus*	Chest *B. subtilis. (?)* *B. equisepticus*			Belly *B. subtilis.* *B. coli comm.*		Right Leg *B. subtilis. (?)* *Staphylococ.*	Belly *Unident. bac.*	Belly *No growth.*				Chest *No growth.*
Oedema of			Groin *Unident. bac.*	Left Thigh *B. coli comm.* *Unident. bac.* *B. pyrogenes eq.*							Left Shoulder Joint *B. subtilis. (?)* *B. equisepticus*											
Abscess of	Back *Unident. bac.* *B. coli comm.* *B. equisepticus*			Right Hip *B. coli comm.* *Streptococcus.*	Spleen *B. pyrogenes eq.* *Unident. bac.* *B. equisepticus.*				Stifle Joint *B. pyrogenes eq.* *B. equisepticus.*	Right Flank *B. pyro. eq.* *B. equisepticus*	Biceps *Streptococcus.* *B. equisepticus*											
Abscess of	Lung *B. equisepticus*			Sciatic Region *B. coli comm.*																		
Joint Fluid	*B. equisepticus.*	*No growth*	*Unident. bac*	*Streptococcus.*	*Staphylococcus* *B. equisepticus*	*B. pyrogenes eq.*		*B. equisepticus.*	*B. equisepticus*	*B. equisepticus.*	*B. equisepticus.*		*Unident. bac.*	*No growth*	*No growth*	*B. equisepticus.*		*Staphylococcus.*				*B. equisepticus.*
Heart's Blood	*No growth*	*No growth*	*Unident. bac*		*Unident. bac.* *B. equisepticus*	*Unident. bac.* *Staphylococcus.* *B. pyrogenes eq.* *B. equisepticus*		*No growth*	*B. equisepticus*	*Unident. bac.* *B. equisepticus*	*B. equisepticus*	*B. subtilis* *B. equisepticus*	*Unident. bac. (4)*	*Dipl. pneumoniæ* *Unident. bac.* *B. equisepticus*	*No growth*	*B. equisepticus*	*Unident. bac*	*Unident. bac*	*No growth*	*No growth*	*Streptococcus*	*B. coli comm. (?)* *Streptococcus.*
Jugular Blood	Carotid *B. equisepticus*			*Unident. bac. (2)* *B. pyrogenes eq.* *B. equisepticus*	*Unident. bac*		*B. coli comm.* *B. pyrogenes eq.* *Unident. bac. (3)*		*Unident. bac.*	*B. equisepticus.*						*Staphylococcus.* *Unident. bac.*						*B. coli comm. (?)* *Streptococcus.* *B. equisepticus.*
Pericardial Fluid		*B. equisepticus?*	*Unident. bac*			*B. pyrogenes eq.* *Unident. bac.*		*B. equisepticus*	*B. equisepticus*	*B. equisepticus*	*B. equisepticus*		*Unident. bac.*	*B. coli comm.* *Staphylococcus.*	*No growth*	*No growth*	*No growth*	*No growth*				*No growth*
Pleural Cavity				*Staphylococcus.*		*Unident. bac.*		*B. equisepticus.*		*B. equisepticus.*			*Streptococcus.*	*Unident. bac. (2)*	*Staphylococcus.* *Unident. bac. (4)*	*B. equisepticus.*	*No growth*	*Streptococcus.*				
Lung		*B. equisepticus?*		*Unident. bac. (2)*	*Unident. bac*	*B. coli comm.* *Unident. bac.* *B. pyrogenes eq.*		*Dip. pneumoniæ* *B. equisepticus*	*B. pyrogenes eq.* *B. equisepticus*	*B. equisepticus*	*B. subtilis (?)*	*No growth*	*Unident. bac*		*Unident. bac*	*B. equisepticus*	*Unident. bac*	*No growth*	*No growth*	*Diplococcus.* *B. equisepticus*	*Unident. bac*	*Unident. bac.*
Mediastinal Gland	*Diplococcus.* *Staph. albus.* *B. equisepticus.*	*B. equisepticus?*	*B. equisepticus?*			*B. pyrogenes eq.*																*No growth*
Peritoneum				*Unident. bac.* *B. coli comm.* *B. pyrogenes eq.*	*Unident. bac.*			*B. coli comm.* *Dipl. pneumoniæ (?)*		*B. equisepticus.*	*B. coli comm.* *Streptococcus*			*No growth*	*No growth*	*No growth*	*No growth*	*No growth*				
Peritoneal Gland			*Unident. bac*	*B. pyrogenes eq.* *B. coli comm.* *Unident. bac. (2)*	*Unident. bac*	*B. pyrogenes eq.*		*No growth*							*No growth*	*B. equisepticus.*						
Spleen	*No growth*	*Unident. bac*		*B. coli comm.* *B. pyrogenes eq.*	*Unident. bac.* *B. equisepticus*	*B. pyrogenes eq.*		*No growth*	*Unident. bac.* *B. equisepticus*	*B. equisepticus*	*B. subtilis (?)* *B. equisepticus*	*B. coli comm.* *B. subtilis.*	*Unident. bac.*	*Unident. bac.* *B. equisepticus*	*No growth*	*B. equisepticus*	*Unident. bac.* *B. equisepticus*	*B. subtilis*	*Unident. bac.* *B. equisepticus*	*B. equisepticus*	*Staphylococcus.* *B. equisepticus*	*B. equisepticus.*
Liver	*B. equisepticus*	*Unident. bac*	*B. equisepticus?*	*B. pyrogenes eq.* *Staphylococci.* *Unident. bac. (2)*	*Unident. bac.* *B. equisepticus*	*B. coli comm.* *Unident. bac.*		*Unident. bac.*	*Unident. bac.* *B. equisepticus*	*Streptococcus.* *B. equisepticus*	*B. equisepticus*	*B. coli comm.* *B. subtilis*	*Unident. bac. (2)*	*Unident. bac.* *B. equisepticus*	*No growth*	*B. equisepticus*	*Unident. bac.* *B. equisepticus*	*Streptococcus.* *B. equisepticus*	*B. equisepticus*	*Unident. bac. (2)*	*B. equisepticus*	
Kidney			*B. coli comm. (?)*	*B. pyrogenes eq.* *Unident. bac. (2)*	*Unident. bac*	*B. coli comm.* *Unident. bac.*		*Dipl. pneumoniæ (?)*	*Staphylococcus.* *B. pyrogenes eq.* *B. equisepticus*	*Unident. bac. (2)* *B. equisepticus*	*B. subtilis (?)*		*B. coli comm.*	*No growth*	*Unident. bac*	*No growth*	*No growth*	*Streptococcus*	*Diplococcus.*		*No growth*	{ *Unident. bac.* { *B. coli comm.* { *Streptococcus.*
Urine	*No growth*					*Unident. bac.* *B. pyrogenes eq.*			*B. pyrogenes eq*		*B. equisepticus*				*No growth*		*No growth*					
Miscellaneous			Right Shoulder and Gland Groin. *Unident. bac.*	Spinal Cord *Unident. bac. (2)*		Sp. Canal, Eye and Lumbar Gland. *B. pyrogenes eq.* Sp. Canal and Eye. *B. coli comm.* *Unident. bac.*				Corpus Luteum. *No growth.*				Heart Wall *Unident. bac.* *B. equisepticus*								

* These specimens were collected during life. The horse died one week later, and no autopsy could be held. †Infected at Hallock, moved to St. Cloud.

TABLE III. SHOWING RESULT OF CULTURES MADE DURING LIFE OF HORSES IN WHICH A DIAGNOSIS OF "SWAMP-FEVER" SEEMED CORRECT.

Horse No.	Owner.	Locality.	Date of Examination	Cultures from Blood Stream.	Cultures from Other Sources.	Fate of Animal.	Bacterial Findings at Autopsy.
10	W. S....	Beltrami.....	July 24, '02..	B. subtilis (?). Skin (?)........	....	Killed, autopsy Aug. 19, '02......	B. pyrogenes eq. B. equisepticus. Other bacteria.
12	H. P....	Beltrami.....	Aug. 1, '02..	B. pyrogenes eq. Other bacteria..	Oedema chest—B. pyrogenes eq. and other bacteria.................	Died Aug. 8, '02. No autopsy...	
13	J. B. H..	Sauk Rapids..	July 31, '02..	Diplococci....... Other bacteria..	....	Killed 8 hours before autopsy, Sept. 12, '02....................	B. equisepticus. Dipl. pneumoniae. Other bacteria.
14	H. P....	Beltrami.....	Aug. 19, '02.	Unident. bac.....	Urine—sterile	Killed for autopsy, Aug. 26, '02..	B. pyrogenes eq. B. equisepticus. Other bacteria.
15	H. P....	Beltrami...	Aug. 19, '02.. Aug. 26, '02..	B. equisepticus.	Enlarged gland at jaw B. pyro. eq., B. equisepticus, dipl. pneumoniae Hock—no growth.......	Killed for autopsy, Sept. 7, '02..	B. pyrogenes eq. B. equisepticus. Other bacteria.
20	P. M....	Beltrami.....	Aug. 26, '02.	Sterile...........	....	Died Jan. 12, '03, autopsy Jan. 14, '03.......................	B. equisepticus. Other bacteria.
21	P. M....	Beltrami.....	Aug. 26, '02.	Staphylococcus..	....	....	
22	P. M....	Beltrami.....	Aug. 26, '02.	Sterile...........	....	....	
23	L. F	Beltrami.....	Sept. 8, '02..	Contaminated....		....	
25	J. B. H .	Sauk Rapids..	Sept. 12, '02.	Sterile...........	Oedema over sternum—staphylococci...........	Died Oct. 2, '02. No autopsy....	
29	C. C.....	Winnipeg....	Oct. 20, '02..	Sterile...........		....	
30	A. A....	Russia........	Oct. 23, '02..	....	Abscess chest—unident. bac., oedema belly—sterile.................	....	
37	T. H....	Hallock	Feb. 7, '03... Feb. 11, '03..	B. equisepticus..	....	Died Feb. 11, '03................	B. equisepticus. Other bacteria. Streptococcus.

instance have such long chains as those figured by Wertheim* for chicken cholera been encountered.

The bacilli have a marked Brownion movement, but are never motile.

Staining.—This organism does not stain by Gram's method. In specimens prepared directly from the blood or tissues of animals or in 24-hour broth cultures stained by Löffler's alkaline methylene blue, nearly all the bacilli show the ends intensely stained, and the central portion very faintly or entirely unstained. The variation in the length already mentioned, seems to depend upon the length of this unstained middle portion rather than upon the size of the solidly staining ends, as pointed out by Theobald Smith† for swine plague bacilli.

In preparations grown on the surface of solid media for 24 hours and stained with Löffler's alkaline methylene blue, the bacilli are nearly always evenly stained throughout. Only rarely can the belted appearance be noticed. In preparations from solid media older than 24 hours the bacilli do not stain well, but appear as a mass of *debris*, and it is with difficulty that the individual organisms can be distinguished.

Cultures made directly from the tissues or blood upon meat extract, agar and serum, do not grow well and may show no growth, while cultures from the same source made into broth show a fairly abundant growth after 48 hours. After one or two generations in broth, the organism grows much better on solid media. In this manner the organism may be overlooked, even when quite abundant, unless second sowings are made upon solid media from the broth after it has been incubated 24 to 48 hours. During the latter part of these investigations the agar used has been made according to Ravenel's method.§ Agar made in this manner afforded a more abundant growth than any solid media that has been used, which is contrary to the experience of Lignières with his "*bacille ovoide.*"

Cultural Characteristics.—Broth cultures become uniformly but faintly clouded in 24 hours at incubator temperature, more slowly at room temperature. After several days there is usually a faint gray ring on the glass at the surface of the broth. In old broth

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*Archives für Path. und Pharmakol. Bd. XXVI., 1889, p. 61.

†U. S. Bureau Animal Industry, 1891, Special Report on the Cause and Prevention of Swine Plague, p. 85.

§Transactions of American Public Health Association, Vol. XXV., p. 605.

cultures there is sometimes a flocculent precipitate at the bottom of the tube and at others a gray viscid deposit.

In Dunham's peptone solution there appears a very faint diffuse cloudiness in 24 hours. In cultures older than 24 hours a slight flocculent precipitate appears at the bottom of the tube. No indol is formed. The growth on blood serum (Löffler's + 1.25 per cent glycerine) is very fine, fairly abundant with slightly raised even edges, and of the same creamy color as the serum. The serum is not digested. After 24 hours the growth upon plain and glycerine agar slants is abundant, moist and transparent. In cultures older than 24 hours the growth becomes creamy white, drier and viscid, adhering firmly to the surface of the agar.

No visible growth develops upon potato. In gelatine stab cultures a very faint gray growth occurs at the surface and along the track of the needle without liquefaction. Litmus milk is unchanged. Strains of the organism from many sources, sown into litmus milk, have been under observation for several weeks at a time, and in no instance was any change noticed. The growth upon saccharose and maltose litmus agars is moist and transparent. It is more abundant than that occurring upon dextrose and lactose litmus agars. Upon the latter two the growth is very fine, granular and transparent. In cultures older than 24 hours upon the litmus sugar agar media the growth becomes creamy white and viscid as noted for plain agar. There is no change in or upon any of the litmus sugar agar media at any time. The organism does not form gas.

Pathogenesis. (For detailed account, see "Experimental Investigations," page 350.) Twelve of the seventeen strains of this micro-organism were found to be equally virulent, so far as tested. Doses of 0.00000001 c. c. to 1.0 c. c. of a fresh broth culture killed rabbits in less than 16 hours after intravenous inoculation. A series of tests (Table IV., Experimental Investigations) showed that in most instances death took place in from two and one-half to seven hours after such inoculations. There was no evidence to show that the site selected for inoculation influenced resistance to infection as the results of intravenous, intra-peritoneal and subcutaneous injection, were almost identical.

Guinea pigs, pigeons and English sparrows were all found to be susceptible. White mice, dogs and swine resisted inoculation.

Horses were extremely susceptible, although it has thus far been impossible to reproduce the chronic form of the disease in all

its manifestations, which is probably due to mode of inoculation or extreme virulence of the organism.

Bacillus Pyrogenes Equinus—A bacillus whose cultural and other characteristics permitted of its easy identification was obtained from five cases of swamp fever at autopsy (Nos. 9-10-11-14-15), and from one case examined while alive (No. 12).

As will be seen from the description of this micro-organism, it is capable of producing hemorrhages and other lesions in the horse, as well as fatal results in these and other animals. The part that it plays, if any, in swamp fever is as yet unknown. So far as has been ascertained this micro-organism has not been described in connection with other diseases of horses, nor has it been found by this laboratory in the tissues of normal horses or horses suffering from any other disease nor in fact in any other site than the tissues of these six cases of "swamp fever."

The following is a description of *B. pyrogenes equinus*, so named on account of its power of producing very marked pyrexia when inoculated into these animals.

Morphology is a motile, rod shaped bacillus with blunt ends. It is indistinguishable in size and morphology from *B. coli communis.* In broth cultures, chains of two and rarely three, bacilli can be seen. The organism is actively motile. It does not form spores.

Staining.—It stains deeply and evenly with Löffler's alkaline methylene blue. It does not retain the stain by Gram's method.

Cultural Characteristics.—Twenty-four-hour broth cultures are uniformly cloudy, have a slight flocculent precipitate at the bottom of the tube and a white granular ring on the glass at the surface of the broth. Old broth cultures have a fairly heavy, gray, wrinkled pellicle over the surface and a heavy white precipitate at the bottom of the tube. When shaken up the pellicle breaks into small scales and falls to the bottom.

The growth in Dunham's peptone solution is very slight. After 48 hours there is uniform cloudiness and a thin gray film over the surface of the medium. A trace of indol is formed.

On blood serum (Löffler's + 1.25 per cent glycerine) the individual colonies after 24 hours are small, moist, gray and rounded. In older cultures the colonies increase in size, become flattened, dryer, and have one or two concentric ridges. When the sowing is heavy the growth in 24 hours is fairly abundant, granular, and is roughened near the edges. Upon close examination this roughness along the edges is seen to consist of very small wrinkles. As the cultures get older, the wrinkling becomes general over the whole

growth. The growth appears dry, and does not seem to increase in thickness except where the wrinkles occur.

The growth on the surface of plain agar is very characteristic, and serves to distinguish the organism from *B. coli communis*, as well as all other bacteria met with in this laboratory. After 24 hours small individual colonies are moist, rounded and transparent. As the colonies get older they increase in size, become gray, dry, appear to flatten out, and have one or two concentric ridges. They are thicker in the center than at the edges, which causes them to look terraced.

In moderately heavy sowings made with a loop on the surface of agar, the growth looks like a thin, gray, finely corrugated membrane stretched over the surface of the agar, with occasionally a heavy wrinkle. The corrugations are small wrinkles, and as the culture gets older the growth, which takes place principally in a plane parallel with the surface of the medium, does not appear to increase in thickness, but the wrinkles become larger and extend in all directions, as if some resistance had been met with at the edges which caused the membrane to wrinkle in the center. The original development of wrinkles is seen best where individual colonies are few in number; then, as the colonies increase in size and become confluent, the wrinkles occur at the points of contact. When the growth is very abundant wrinkling does not occur.

On potato the growth is moderately heavy and wrinkled. It has a peculiar silver white metallic luster. A heavy wrinkled pellicle forms over the water in the bottom of the tube.

In gelatine stab cultures a faint gray growth occurs at the surface, and along the track of the needle after 48 hours without liquefaction.

Litmus milk becomes faintly acid in 24 hours. Later it becomes alkaline, a gray sediment forms at the bottom of the tube and a thin scaley pellicle forms over the surface. The milk is not coagulated.

The growth upon the sugar agar media is rapid and abundant, and has the same general appearance as that upon plain agar.

Litmus dextrose and litmus maltose agars are reddened throughout in 24 hours, accompanied by gas formation.

Litmus lactose and litmus saccharose agars are unchanged after 24 hours; in older cultures the medium becomes a deep blue. No gas formation takes place in these latter two.

In dextrose broth the formation of gas is rapid and abundant. The gas reaction varies from $\frac{H}{CO_2} = \frac{3}{1}$ to $\frac{H}{CO_2} = \frac{7}{1}$

Pathogenesis. (For detailed account, see "Experimental Investigations," page 361.) The pathogenesis of *B. pyrogenes equinus* has not been studied as thoroughly as that of *B. equisepticus,* since it was only found in six of the cases, and in but two of the outbreaks of swamp fever investigated. In small doses of fresh broth cultures rabbits were killed in from one to eight days. Hemorrhages on the serous surfaces were found at autopsy, and the bacillus recovered from the tissues and blood stream. Horses were susceptible to intravenous injection, large doses producing death in three or four hours, small repeated doses producing extreme elevation of temperature.

The relationship of this organism to swamp fever, if it has a relationship, cannot be stated at this time. The fact that it has not been met with in this laboratory, except in cases of swamp fever, that it produces hemorrhages on serous surfaces in both rabbits and horses, and a peculiar yellowish or gelatinous œdema, such as that found in certain of the swamp fever cases at autopsy, would naturally direct atention to it as a possible or probable ætiological factor in the disease, were it not for the finding of *B. equisepticus* in practically all cases of swamp fever which came to autopsy.

8. **Diagnosis.**—Weakness is usually the first symptom noticed. The animal is "out of sorts," sweats easily, and is not able to do its accustomed amount of work. Gradual emaciation and anæmia, as evidenced by the pale and often jaundiced mucous membranes—occasional petechial hemorrhages—when accompanied by unimpaired or voracious appetite, and the characteristic staggering gait constitute a train of symptoms which cannot be easily mistaken.

The voiding of large quantities of urine at frequent intervals is often to be observed, and at late stages of the disease patches of œdema often appear upon the chest, belly and legs.

The presence of these symptoms and the demonstration of *B. equisepticus,* at autopsy, afford a basis for absolute diagnosis. The experience derived from these investigations seems to show that *B. equisepticus,* can rarely be obtained from the blood during life.

In those cases in which œdematous patches, abscesses or synosial effusion occur, it is frequently possible to show the presence of *B. equisepticus* in fluids obtained from these sources provided sufficient quantities of fluid are used for sowing large quantities of broth.

9. **Prognosis.**—The prognosis of the disease is very unfavorable. The mortality in the cases studied by this board is over 80 per cent.

Many believe that recovery never takes place, and when recovery is reported they doubt the diagnosis. Some well marked cases, however, do apparently recover, but the animals rarely regain their accustomed vigor.

10. Treatment.—Medication seems to be of doubtful value, although in general tonics and stimulants are indicated. Iron, arsenic, quinine, strychnine and various compounds have been employed, with varying results.

Early in these investigations the futility of the ordinary method of medication became apparent, and plans were made and steps taken for the elaboration of prophylactic and curative measures. The methods employed and the results obtained are reported under "Experimental Investigations," page 369. It is unfortunate that this line of investigation had to be abandoned, since it is one that promised well, but required considerable time for its completion, even with the facilities which this board had been able to provide, just prior to the transference of the study of infectious diseases of animals to other hands.

11. Prophylaxis.—Although the presence of *B. equisepticus* was only demonstrated once in the urine, it is only fair to state that examinations were not frequently made. The marked kidney lesions would seem to warrant a belief that urine may be a frequent vehicle for the spread of the disease.

The presence of hemorrhagic areas in the intestinal wall, and the fact that the "atrium" is probably alimentary, would warrant the assumption that manure may often be the means of transmission. The history of the occurrence of this disease in this state, as well as the above, would serve to show the desirability of excluding swamp or native hay, over which sick animals may have been running, from the diet list. Segregation of sick animals, and their proper disposal when dead, with disinfection of the stalls occupied by them appear to be indicated, notwithstanding the paucity of data tending to show the infectiousness of this disease.

EXPERIMENTAL INVESTIGATIONS.

From the animals and sites mentioned under the details of the individual outbreaks and cases of swamp fever, strains of *B. equisepticus* and *B. pyrogenes equinus* were isolated, studied in pure culture and the effects of their inoculation into various animals noted. In the case of *B. equisepticus* which was obtained from practically all cases of the disease, these studies were much more extensive, and its pathogenesis for the various laboratory animals as well as the

horse, was determined with some minuteness. Not only was its capacity for producing death in the laboratory animals studied, but attempts were made to reproduce the disease by intravenous inoculation. Whilst it was recognized that this method of infection probably differed materially from that which occurred naturally, and plans were made for feeding and inhalation experiments, it was deemed best to begin by the method likely to produce with most certainty the infection of the animal.

The necessity for concluding the experiments and making a report at this time, renders further apology or explanation for the incompleteness of results unnecessary.

Pathogenesis of Bacillus Equisepticus.—*B. equisepticus*, as obtained from the different clinical cases of swamp fever in this investigation, would seem to be not only of extreme, but of constant virulence. Of the seventeen strains of the organism obtained at autopsy, or from fluids or tissues of horses suffering from this disease, twelve have been tested by inoculation into animals and were found highly virulent for rabbits in comparatively small doses. Reference to the details of laboratory findings given for each case investigated, will show that small doses of fresh broth cultures invariably killed rabbits within a few hours after inoculation (i. e., animals inoculated one day were found dead on the following morning, almost without exception).

As a rule, when pathogenesis was thus demonstrated, no further inoculations were made, since one particular strain, viz., that obtained from Case 34, was studied very thoroughly, and the virulence accurately measured. Whether the same virulence could have been demonstrated for all strains, cannot be definitely stated.

Most of the inoculations were given intravenously, but in general, from the observations made in the laboratory, it would appear that the onset of symptoms was not more rapid, nor the virulence exhibited greater after intravenous, than after subcutaneous and intraperitoneal administration. The initial high grade of virulence of the cultures obtained from the tissues of horses sick with the disease did not seem to be increased by passage through rabbits, horses, or other animals. Rabbits inoculated in the afternoon were found dead the following morning with such regularity that it was determined to find out the time taken to produce death, and the minimal lethal dose. The strain isolated from Case 34, was chosen for the experiments, since it was the most recently isolated strain at the time. The results in detail are shown by the following table:

TABLE IV.—SHOWING VIRULENCE AND MINIMUM LETHAL DOSE OF BACILLUS EQUISEPTICUS.*

Rabbit Number.	Weight in Grams.	Origin of Culture.	Age of Broth Culture—hrs.	No. of Times passed thro. Animals.	How Inoculated.	Amount of Inoculation in c.c.	Time Elapsed until Death.	B. Equisepticus Recovered Unmixed.	Autopsy Findings.
634	810	Liver of horse, swamp fever. Case 34	22	......	Intravenous..	1.0	3 hrs. 50 mins.	No autopsy..	....
632	1810	Liver of horse, swamp fever. Case 34	48	......	Intravenous..	1.0	2 hrs. 30 mins.	Yes..........	No gross lesions.
711	1970	Liver of rabbit. 708..........	24	7	Intravenous..	1.0	4 hrs. 50 mins.	Yes..........	Froth flowed from nostrils. Lungs hemorrhagic (swine plague). Large amount bloody serum in pleural cavity. Pericardial fluid increased. Small abscess in middle lobe of liver near margin.
755	2060	Heart's blood of rabbit. 751..........	24	9	Intravenous..	0.4	7 hours.......	No autopsy..	....
605	2050	Abscess, biceps, horse, swamp fever. Case 19..........	60	......	Intravenous..	1.5	6 hours.......	Yes..........	Hemorrhages into uterus and tubes. Lungs congested. No other gross lesions.
702	702	Lung of exp. horse 6, swamp fever. Case 11..........	24	2	Intravenous..	1.0	5 hrs. 15 mins.	Yes..........	Lungs congested. Pleural cavity contained large amount of bloody serum.
635	710	Liver of horse, swamp fever. Case 34..........	48	......	Subcutaneous	0.5	16 hrs. or less†	Yes..........	Slight straw colored exudate at site of inoculation. Many minute hemorrhages in thymus gland and heart muscle. Bloody exudate in pleural cavity.
650	....	Heart's blood of rabbit. 640..........	24	2	Intravenous..	.000,001	16 hrs. or less†	Yes..........	Right lung hemorrhagic. Large amount of clear serum in pleural cavity.
638	2070	Rabbit. 633..........	24	1	Intravenous..	.000,001	16 hrs. or less†	Yes..........	Lungs "swine plague." Pleural and pericardial cavities contained an increased amount of clear serum.
646	2100	Rabbit. 633..........	24	1	Intravenous..	.000,001	Not killed....	....	....
639	1860	Rabbit. 633..........	24	1	Intravenous..	.000,000,1	16 hrs. or less	Yes..........	Same as No. 638.
640	1820	Rabbit. 633..........	24	1	Intravenous..	.000,000,1	16 hrs. or less	Yes..........	Lungs "swine plague." Minute hemorrhages into heart muscle. Large amount of clear serum in pleural and pericardial cavities.
643	1600	Heart's blood of rabbit. 640..........	24	2	Intravenous..	.000,000,1	40 hrs. or less	Broth found to be acid. No growth..	Right lung congested, "swine plague." Pleural and pericardial cavities contained large amount of clear serum.
641	1070	Heart's blood of rabbit. 640..........	24	2	Intravenous..	.000,000,01	16hrs. or less	Broth found to be acid. No growth..	Lungs hemorrhagic. No other gross lesions.
642	2050	Heart's blood of rabbit. 640..........	24	2	Intravenous..	.000,000,01	16 hrs. or less	Broth found to be acid. No growth..	Same as No. 641.
644	1680	Heart's blood of rabbit. 640..........	24	2	Intravenous..	.000,000,1	Not killed....	....	....

* These cultures were all obtained from "Swamp Fever" case 34.
† 16 hours or less in this column means that the rabbits were inoculated between 3 and 6 p. m. and found dead the following morning between 7 and 8 a. m.

A study of the foregoing table serves to show:

1. The extreme virulence of the organism which in doses of 0.4 to 1 c. c. killed rabbits in from two and a half to seven hours. This is the most virulent organism encountered in the experience of this laboratory.

2. The disease produced in the rabbits is a true *septicæmia,* although at first the rapid course of the disease was attributed to toxin production. The minuteness of the dose (.000,000,01 to .000,001 c. c.) required to produce death in from sixteen to forty hours or less, would stamp the process as a septicæmia. By plating out the same quantities from the same syringe used for these smallest doses it was computed by the number of colonies which developed that from one to eight bacilli sufficed to produce a septicæmia with death, in less than sixteen hours. The demonstration of living micro-organisms in the tissues, blood and organs of animals which succumbed to intraperitoneal and subcutaneous injections, as well as those intravenously inoculated, is further proof of their septicæmic nature, whilst observations on clinical cases and horses experimentally inoculated, corroborate the point.

3. No very marked gross lesions followed the inoculation of *bacillus equisepticus* into rabbits, with the exception of hemorrhages noted in the various glands and organs, and on the different serous surfaces, and an increase of fluid in the cavities.

Guinea Pigs.—Guinea pigs were found susceptible to this organism, but were slightly more resistant than rabbits. The lesions found at autopsy were practically the same as those found in rabbits.

It was found unnecessary to employ guinea pigs for isolating *B. equisepticus,* in pure culture, although intraperitoneal inoculation of these animals, was the method used by Lignières in his observations.

Pigeons.—Pigeons were found extremely susceptible to this organism. As small a dose as .000,001 of c. c. of a 24-hour broth culture inoculated into the breast muscle, produced death in less than 24 hours.

English Sparrows.—The English sparrow is susceptible to this organism when inoculated into the breast muscle with small doses.

White Mice.—No extensive observations were made in the employment of this animal for inoculation experiments, but it would appear that it is not as susceptible as guinea pigs, rabbits, and pigeons.

Dogs.—Dogs were resistant to intravenous inoculations of this organism. Subcutaneous inoculation caused extensive œdema, at the site of inoculation, followed by ulceration of the skin and granulation of the wound. Loss of appetite and depression are apparent for several hours after inoculation.

Swine.—Swine do not appear to be susceptible to this organism when given intravenously or subcutaneously. As much as 30 c. c. of a 24-hour broth culture, has been given intravenously without producing any noticeable results.

Horses.—The following detailed statement of inoculation experiments into horses show the effect produced by large individual and repeated small doses of *B. equisepticus*, injected into the blood stream.

Experiment Horse No. 4.—Bay mare, weight about 900 pounds. This horse had been at work for several months previous to this time, and was apparently strong and healthy. She was in fair condition.

Dec. 22, 1902, blood examination was as follows:

Hæmoglobin (Tallquist), 80 to 100 per cent; red cells, 10,640,000; leucocytes, 8,000.

Dec. 23, 1902, at 10:30 a. m., this animal was inoculated into the jugular vein with 10 c. c. of a 24-hour broth culture of *B. equisepticus*, from "swamp fever" Case No. 34. The culture used was obtained from Rabbit No. 633 (first passage through animals). This inoculation produced, within an hour, diarrhœa, a very marked temporary polyuria, rapid labored respiration, and later rigors followed by profuse sweating. The temperature gradually increased to 103.6° F. at 11:30 p. m. The next day the temperature had receded to 102° F. December 26th, the temperature had reached 101° F. and the animal appeared entirely well. At 11:30 a. m. on this date, a second inoculation of 12 c. c. of a 24-hour broth culture of *B. equisepticus*, from Case No. 34, the culture inoculated being from Rabbit No. 640 (second passage through animals), was given into the jugular vein. A portion of the inoculation material escaped into the subcutaneous tissues of the neck, causing a tumor about one and one-half inches in diameter. This became extremely sensitive on the second day and later developed into an abscess which was incised Dec. 30, 1902 (4 days after the inoculation), and about one ounce of yellow blood-streaked pus evacuated. Cultures from this pus gave *B. equisepticus* in pure culture. This abscess discharged pus for a few days and then healed. On this same day,

cultures were taken from the blood for bacteriological examination. After being incubated for 48 hours, no growth appeared. This inoculation produced diarrhoea, marked temporary polyuria, and labored respiration. One and one-half hours after inoculation there was a severe chill followed by profuse sweating. Two hours after inoculation the temperature was 106.8° F., respiration 52 and pulse 62. In two days the animal had apparently recovered.

Dec. 29, 1902, blood examination was as follows:

Hæmoglobin (Tallquist), 80 to 100 per cent; red cells, 8,104,000; leucocytes, 18,000.

At 10:30 a. m. the same date, and three days after the previous inoculation, a third intravenous inoculation was made of 30 c. c. of a 24-hour broth culture of *B. equisepticus* (Case No. 34) from Rabbit No. 640 (2d passage through animals) and 10 c. c. of a 48-hour broth culture of *B. equisepticus* (Case No. 34) from Rabbit No. 633 (1st passage through animals). This inoculation produced the same symptoms as the previous ones, namely, diarrhoea polyuria, labored respiration, rigors and profuse sweating, but all the symptoms were more severe. Two hours after the inoculation the animal was lying down and could not be compelled to get up again during the day. The temperature on this occasion did not rise as high as previously, 104.2° F. being the highest, five hours after inoculation.

Dec. 31, 1902, a swelling appeared in the left hock joint. This was quite sensitive and gave fluctuation. The animal held the left foot from the floor and stepped upon it only when compelled to do so. This swelling continued and finally the whole leg became swollen and sensitive, and was practically useless to the animal from this time on.

Jan. 7, 1903, blood examination was as follows:

Hæmoglobin (Tallquist), 70 per cent; red cells, 8,932,000; leucocytes, 17,000.

On this date the skin over a portion of the left hock joint was seared with a hot iron and a glass pipette introduced into the joint cavity. A small amount of clear, straw-colored serum was drawn off, for the purpose of making cultures. These cultures gave *B. equisepticus* unmixed with other organisms.

Jan. 1, 1903, the animal was down and unable to get up. From this time on, emaciation was rapid and accompanied with gradually increasing weakness. The appetite, however, remained good. From time to time the animal was raised in the sling, for the purpose of rest, and to prevent injury in its efforts to get up.

Jan. 17, 1903, blood examination was as follows:

Hæmoglobin (Tallquist), 70 to 80 per cent; red cells, 7,336,000; leucocytes, 12,000.

Jan. 26, 1903, blood examination was as follows:

Hæmoglobin (Tallquist), 70 per cent; red cells, 8,742,000; leucocytes, 39,000.

By this time the animal had become so weak that it was thought best not to keep her longer. In order to determine whether or not any immunity had been established, it was decided to inoculate with a large dose of *B. equisepticus.* Consequently she was inoculated intravenously at 10:45 a. m. with 210 c. c. of a 24-hour broth culture of *B. equisepticus* from the spleen of Experiment Horse No. 5 (originally from Case No. 34). This inoculation produced severe symptoms of prostration within an hour, and the horse died at 2:45 p. m. from collapse.

Autopsy, five p. m., Jan. 26, 1903. Autopsy notes taken at this time, were as follows:

Autopsy was held by lamplight, and therefore it was very difficult to see the lesions. Low down in the neck on left side, there was a small tumor running parallel with the jugular vein. Upon opening this the surrounding tissues were thickened and yellowish. The tumor contained a clear straw-colored fluid. Beneath the skin over the ribs were several hemorrhages. These did not appear to be recent. The heart was very large and contained a large chicken fat clot in the left auricle. Over both the external and internal surfaces of the heart muscle were numerous hemorrhages, varying in size from a pin point to the size of a pea. These were very dark colored and were especially marked along the area, between the ventricles. The lungs contained many petechial hemorrhages, and some larger ones. The liver and kidneys were apparently normal. The spleen was mottled over its entire surface with small hemorrhages. Several of the mesenteric glands of the small intestine were enlarged and hemorrhagic. The left hock was opened. All the surrounding tissues were much thickened and hemorrhagic. The joint itself contained a small amount of sero-sanguineous fluid.

Cultures were taken from the lung, heart's blood, kidney, liver and spleen. Cultures from the spleen showed *B. equisepticus* in pure culture. Cultures from the liver showed *B. coli communis* in pure culture. No growth appeared in or on the cultures taken from the lung, kidney and heart's blood.

Experiment Horse No. 12—Brown horse, weight about 1,100 pounds. This horse was old, thin and had been foundered. It was very lame in both front legs. He had been fed from Jan. 30 to March 13, 1903, on ensilage (see page 156, this report). Since no evil results were obtained from the previous experiment, it was thought advisable to use him again.

March 25, 1903, the blood examination was as follows:

Hæmoglobin (Tallquist), 100 per cent; red cells, 7,904,000; leucocytes, 11,000.

At 4 p. m. on this date, the animal was inoculated intravenously into the jugular vein, with 10 c. c. of a 24-hour broth culture of *B. equisepticus* from Rabbit No. 718 (eighth passage through animals, from Case No. 34). At 5 p.m. the respirations were labored, the horse was trembling and refused food. At 7:25 p. m. the temperature had reached 105.2° F. The horse was sweating, but otherwise appeared improved. The next morning the temperature was 101.8° F. There was diarrhoea and polyuria. The urine looked very red, but was not examined, and the horse's hind legs appeared to be weak.

On March 27, 1903, two days after inoculation, the horse did not eat well, there was a slight effusion in the left hock and considerable lameness in this leg. The horse appeared to be very weak and scarcely able to stand. During the night the horse lay down and had to be raised in the sling the next morning. From this time on the horse was never able to get up alone, and was raised in the sling at various times, for the purpose of rest and to prevent injury in his efforts to get up. The left hind leg became very much swollen and extremely sensitive.

March 31, 1903, the blood examination was as follows:

Hæmoglobin (Tallquist), 100 per cent; red cells, 8,412,000; leucocytes, 26,000.

On April 3, 1903, the animal appeared stronger, ate well, and was able to stand when the sling was removed. From this time on there was gradually increasing weakness and emaciation. The appetite was only fair. During the night of April 9, 1903, the animal died.

Autopsy was held at 9 a. m. the morning of April 10. Autopsy notes are as follows:

The left shoulder contained a large superficial abscess, discharging pus, which was probably caused from injury. The left hind leg contained a large abscess on its inner aspect, along the popliteal

artery, which contained fluid pus. This hind leg had been swollen and very sensitive for more than a week. The hock joint contained a considerable amount of clear straw-colored fluid. The tissues about the hock joint were very much thickened. The left lung was almost solid, and very dark red. This was probably due in a large part to hypostatic congestion. The horse had lain on its left side at different intervals for several days. The left side of the pericardium was covered with large, dark hemorrhages. The right lung was slightly congested in the anterior lobe, but otherwise appeared normal. The left heart contained a large "chicken-fat" clot. The endocardium was covered with hemorrhages. The heart weighed 11 pounds. The liver weighed 18 pounds. Its surface was covered with stringy masses of fibrin. Otherwise it appeared normal. The spleen weighed three and one-half pounds, and appeared to be normal. The kidneys appeared to be normal. The large mesenteric artery was slightly thickened and contained *strongyli armati*, but no clots.

Experiment Horse No. 7.—Black pony, white face and feet; weight about 850 pounds. This pony was in good flesh, and apparently in good health, except that it had the "heaves."

Jan. 12, 1903, blood examination was as follows:

Hæmoglobin (Tallquist), 70 to 80 per cent; red cells, 6,120,000; leucocytes, 18,000.

At 12:30 p. m. on this date the animal was inoculated intravenously into the jugular vein with 10 c. c. of a 24-hour broth culture of *B. equisepticus*, obtained from the spleen of Experiment Horse No. 5 (originally isolated from "swamp fever" Case No. 34). In one half an hour this produced a rapid, labored respiration, with a gradual rise of temperature, reaching 103.8° F. at 3:30 p. m. The next day the horse was apparently fully recovered.

Jan. 19, 1903, the blood examination was as follows:

Hæmoglobin (Tallquist), 80 to 90 per cent; red cells, 7,428,000; leucocytes, 20,000.

Jan 30, 1903, at 10:45 a. m., the animal was inoculated intravenously into the jugular vein with 10 c. c. of a 24-hour broth culture of *B. equisepticus*, obtained from the spleen of Experiment Horse No. 4 (strain from Case No. 34). This produced the same symptoms as the previous inoculation. The temperature reached 102.6° F. at its highest, at 4 p. m. As in the previous inoculation, the horse appeared entirely well the following day.

Feb. 3, 1903, blood examination was as follows:

Hæmoglobin (Tallquist), 80 to 90 per cent; red cells, 9,920,000; leucocytes, 7,000.

At 10:15 a. m. on this date the animal was again inoculated intravenously into the jugular vein with 20 c. c. of a 24-hour broth culture of *B. equisepticus*, obtained from the spleen of Experiment Horse No. 4. The same symptoms were again noted, as in the previous inoculations. The temperature reached 105.5° F. at its highest, at 3 p. m. The animal had apparently entirely recovered the following day.

Feb 17, 1903, the blood examination was as follows:

Hæmoglobin (Tallquist), 90 per cent; red cells, 10,608,000; leucocytes, 11,000.

At 11:15 a. m. on this date, the animal was inoculated intravenously into the jugular vein with 40 c. c. of a 24-hour broth culture of *B. equisepticus*, obtained from the spleen of Experiment Horse No. 4. Within 15 minutes the respiration became rapid and labored, diarrhoea appeared, there was much escape of fluid from the mouth and profuse sweating. At 12 m. the temperature was 100.2° F. and the animal appeared to be slightly better. At 2 p. m. the animal seemed to be in about the same condition, and was still standing. At 2:30 p. m. the horse was found dead.

At 4:30 p. m. an autopsy was made. Autopsy notes are as follows:

The subcutaneous tissues were fairly normal. The lungs showed a number of small dark hemorrhages. The anterior lobes were markedly emphysematous with patches of consolidation. The remaining anterior half of the lungs was congested; in fact, the lungs were more or less congested, and did not collapse as they should when the chest was opened.

The pericardium contained little fluid. The heart showed many small petechial hemorrhages on its external surface, but none on the internal. All the cavities of the heart were distended with very black clotted blood, which did not tend to change rapidly on exposure to air. The intestines were normal, with the exception of a small area of congestion in the large colon. The mesenteric artery was diseased, and contained *strongyli armati*. The spleen, kidneys, liver and bladder were apparently normal.

Cultures were take from the spleen, heart's blood, kidney, lung and liver.

Cultures from the spleen and heart's blood gave *B. equisepticus* in pure culture. Streptococcus in pure culture was obtained from

the kidney. There was no growth in cultures from the lung and liver.

Experiment Horse No. 14.—An old roan mare in good flesh. Weight about 1,100 pounds. Had the "heaves."

April 4, 1903, the blood examination was as follows:

Hæmoglobin (Tallquist), 100 per cent; red cells, 6,632,000; leucocytes, 5,000.

At 11 a. m. on this date the animal was inoculated intravenously into the jugular vein, with 5 c. c. of a 24-hour broth culture of *B. equisepticus* obtained from Rabbit No. 741 (ninth passage through animals from Case No. 34).

At 12 M., the temperature was 101° F., respirations were labored and rapid, aside from this no other symptoms were noted. About 3:10 p. m. the temperature had reached 104.2° F., respirations 56, and the horse was sweating. The highest temperature noted was 105.5, at 4 p. m. The following day the animal appeared entirely recovered, except that it did not eat well. Temperature at 10 a. m. was 102.4° F., and at 4:30 p. m. was 101.8° F. On the third day, at 10 a. m., the temperature was 101° F., and the animal appeared to be fully recovered.

April 9, 1903, blood examination was as follows:

Hæmoglobin (Tallquist), 100 per cent; red cells, 7,084,000; leucocytes, 15,000.

At 10 a. m. on this date, the animal was again inoculated intravenously into the jugular vein with 5 c.c. of a 24-hour broth culture of *B. equisepticus* from Rabbit No. 741 (ninth passage through animals from Case No. 34).

At 11:30 a. m., there was diarrhoea, polyuria, the respirations were rapid and labored, and the animal was sweating profusely. Temperature was 102° F. At 1 p. m. the animal appeared to be in the same condition, but the temperature had reached 103.8° F. At 2 p. m. the animal was found dead.

Autopsy was held at 4 p. m. Autopsy notes were as follows:

The lungs were slightly congested in their anterior lobes. The heart was very large and distended with dark bloody fluid. The heart weighed 14 pounds. One small hemorrhage was found on the peritoneal surface of the diaphragm. The liver was very large, and weighed 24 pounds, but appeared to be normal, as was also the spleen and kidney. The large mesenteric artery was much thickened, and contained a few *strongyli armati*, but no clots.

Cultures from the spleen gave *B. equisepticus*. Cultures from

the lung and liver showed a diplococcus (?). Cultures from the kidney and heart showed no growth.

Experiment Horse No. 5.—White mare, weight about 900 pounds. This animal was very old and weak, and had not been worked for some time.

Jan. 2, 1903, blood examination was as follows:

Hæmoglobin (Tallquist), 90 to 100 per cent; red cells, 7,916,000; leucocytes, 12,000.

At 12 m. on this date the animal was inoculated intravenously into the jugular vein with 285 c. c. of a 24-hour broth culture of *B. equisepticus* from Rabbit No. 640 (third passage through animals from Case No. 34). By 12:30 p. m. the respirations were rapid and labored. A diarrhoea had developed, and the temperature was 100.4° F. At 2:45 p. m. the animal was down and could not be made to get up. The respirations continued rapid, and the animal appeared to be in some pain. At 3 p. m. the temperature had fallen to 99° F., respirations were shallow, 60 to the minute, pulse could not be felt. Animal was found dead at 3:20 p. m.

Autopsy at 5 p. m. Autopsy notes: This horse died in three hours and twenty minutes after inoculation, consequently there were no marked lesions. About the right jugular vein, at the site of inoculation, was found considerable bloody exudate, probably due to wounding the vein at the time of inoculation. Small hemorrhages, varying in size from a pin head to the size of a pea, were found scattered over the surface of both lungs. Upon section of the lungs, small hemorrhages were found, some being as large as one-half inch in diameter. The mesenteric arteries were diseased from the effects of *strongylus tetracanthus*. The other organs were apparently normal. Cultures were taken from the jugular blood, the lung, spleen, kidney and liver. Cultures from the spleen and lung, gave *B. equisepticus* in pure culture. No growth was obtained from the cultures taken from the jugular blood, kidney and liver.

Summary—

1. Large doses of the organism (285 c. c. of a 24-hour broth culture produced death in three hours and twenty minutes after intravenous injection, with symptoms of prostration and collapse. (See Experimental Horse No. 5.)

2. Small doses, i. e., 5 to 10 c. c. produced rise of temperature, polyuria, slight uneasiness and a labored respiration and rapid pulse. When repeated in several days, similar symptoms were evoked, but in Experimental Horse No. 14 death resulted in four hours after the second inoculation.

3. Repeated doses led to emaciation, synovitis and abscess production, and would have been followed by death, were it not for the fact that life was prolonged, and the animals made more comfortable by suspension in slings, and giving them opportunity to secure food and drink in the easiest way.

4. At autopsy, the findings were practically those met with in clinical cases of acute swamp fever.

5. The production of anæmia, and the other hæmal changes which occur in swamp fever had not yet been reproduced in these investigations when it was necessary to bring them to a close.

Pathogenesis of B. Pyrogenes Equinus.—Attention was concentrated largely on the pathogenic properties of *B. equisepticus* and for *B. pyrogenes equinus*, rabbits and horses were practically the only animals employed for inoculation.

Rabbits.—One c. c. of a 24-hour broth culture of *B. pyrogenes equinus* causes death in rabbits in from one to eight days, without producing any marked symptoms. At autopsy, hemorrhages varying in size from petechiæ to half an inch in diameter were found in nearly every instance upon the serous surfaces, in the heart muscle and occasionally in the lungs. No other gross lesions were found. The micro-organism was recovered in pure culture from the blood, fluids and tissues, which evidenced the septicæmic nature of the infection produced.

Horses.—A number of horses were inoculated intravenously with broth cultures of this micro-organism. The strains employed for inoculation were derived from swamp fever Cases Nos. 11 and 12. The results of the experiments are shown in the following detailed reports of inoculations.

Experiment Horse No. 9.—An old, weak black mare, in very poor condition. Weight about 800 pounds. Jan. 12, 1903, the blood examination was as follows:

Hæmoglobin (Tallquist), 90 to 100 per cent; red cells, 10,544,000; leucocytes, 6,000.

This animal was inoculated intravenously into the jugular vein at 11:45 a. m. on this date, with 10 c. c. of a 24-hour broth culture of *B. pyrogenes equinus*, obtained from the heart's blood of Experiment Horse No. 6 (second passage through animals), having been obtained originally from "swamp fever" Case No. 12. At 3:30 p. m. the animal had polyuria, but no other symptoms were noticed, except a gradual rise in temperature, which reached 105.3° F. as its highest at 5:30 p. m. The following morning the animal

appeared entirely well, although the temperature was 102.8° F., at 9:15 a. m., but had receded to 100.8° F. at 4:30 p. m.

Jan. 19, 1903, blood examination was as follows:

Hæmoglobin (Tallquist), 90 to 100; red cells, 8,040,000; leucocytes, 15,000.

On Jan. 30, 1903, at 10:45 a. m., the animal was given a second intravenous inoculation of 10 c. c. of a 24-hour broth culture of *B. pyrogenes equinus*, obtained from the jugular blood of swamp fever Case No. 12. This produced no symptoms, except a marked polyuria and hyperpyrexia, which continued for ten days, or until the next inoculation. The temperature reached 107.4° F. the next day, and did not go below 102.6° F. the first three days following the inoculation.

Feb. 9, 1903, at 11 a. m. the animal was again inoculated intravenously with 20 c. c. of a 24-hour broth culture of *B. pyrogenes equinus*, obtained from the jugular blood of swamp fever Case No. 12. At 12 M. the animal was down, and the temperature reached 103° F., the highest point for the day. At 2 p. m., there were slight rigors followed by sweating. Next day the animal was up and appeared better. From this time on the animal began to lose flesh, accompanied by gradually increasing weakness, so that it had to be raised in a sling from time to time. The temperature ranged from 99.8 to 104.2° F., although no further inoculations were made. The appetite remained good.

Feb 12, 1903, the right hock was swollen, sensitive and gave fluctuation. The animal was unable to stand on the leg.

Feb. 16, 1903, when the animal was raised in the sling, it having been down for the greater part of the time on the two previous days, it was noticed that there was an abscess on the right ear, another about two by three inches on the right side, about the middle of the seventh rib, and there was a large œdematous area about five by eight inches under the belly.

Feb. 18, 1903, cultures were taken from the œdematous patch under the belly, from the abscess on the side, and from the right hock. Cultures from the abscess and the œdema under the belly gave *B. pyrogenes equinus* unmixed with other organisms. The cultures from the right hock gave no growth.

Blood examination on this date was:

Hæmoglobin (Tallquist), 90 to 100; red cells, 6,444,000; leucocytes, 14,000.

Feb. 21, 1903, the animal was so weak it was thought best not to

keep her longer, and she was killed by bleeding, and an autopsy made at once.

Autopsy notes are as follows:

All the subcutaneous fat was of a peculiar yellowish color, almost orange. There was one large hemorrhage, one by two inches, in the subcutaneous tissue of the abdomen. There was an abscess on the right ear which discharged yellow pus several days before death. This was probably due to an injury received when the horse was down the first time. On the right side, about the middle of the seventh rib, was an abscess, two by three inches in diameter, filled with yellow pus. When cultures were taken from this abscess three days before death, there seemed to be no pus in the abscess, but a clear serum. The œdema under the belly had disappeared at the time of death. The right hock joint was enlarged, and filled with clear serum. Culture taken in a pipette from this joint two days before death, gave no growth. At the time of death all the tissues around this joint were very much thickened. It contained a small amount of straw-colored fluid and a few points of organized tissue, somewhat blood-stained.

Upon opening the thorax all the fat about the internal organs was the same dark yellow color as that in the subcutaneous tissues. The lungs contained many petechial hemorrhages on the surface and a few areas of collapse. Upon section they appeared to be quite solid and contained many areas of hemorrhage. The connective tissue appeared somewhat increased in amount and was yellowish in color. The pericardium contained a small amount of straw-colored fluid. There was one large hemorrhage about one inch in diameter upon the pericardium. The heart appeared normal, excepting a few hemorrhages upon the endocardium. The heart weighed five and three-fourth pounds. There were a few hemorrhages upon the diaphragm. The liver seemed normal. Spleen weighed three pounds and was apparently normal, with the exception of numerous petechial hemorrhages into the capsule. The kidneys were apparently normal, with the exception of a thick, gelatinous substance in the hilum. This gelatinous substance was the same peculiar yellow color as that in other parts of the body.

The abdominal aorta at its point of division into the iliacs was entirely occluded with an old organized clot for about two and one-half inches. The inferior vena cava at this point was also occluded with an old clot. The small vessels about the groin and also about the hock were filled with what appeared to be more recent clots.

Cultures were taken from the heart's blood, lung, liver, kidney and spleen.

From the heart's blood there was obtained a large, evenly staining, non-motile bacillus, which formed a heavy wrinkled pellicle in broth, the lower part of the broth remaining clear. It formed a heavy, white, wrinkled spreading growth on all solid media, and undoubtedly was a contamination.

B. pyrogenes equinus was also obtained from heart's blood.

From the lung there was obtained the same large bacillus as was found in the heart's blood, and *B. pyrogenes equinus.*

From the liver, kidney and spleen *B. pyrogenes equinus* was obtained in pure culture.

Experiment Horse No. 10.—A large brown gelding, weight about 1,300 pounds. This animal was in good condition, but was foundered, and was so lame in both front feet that he moved with difficulty, and lay down in the stall a large part of the time.

Jan. 20, 1903, blood examination was as follows:

Hæmoglobin (Tallquist), 100; red cells, 6,432,000; leucocytes, 11,000.

The horse seemed to suffer so much pain in his front feet that on Jan. 22, 1903, a portion of the median nerve of the right front leg, and a portion of the plantar nerve of the left front leg was excised by Drs. Brimhall and Annand. The next day there was considerable swelling and tenderness in both front legs. Later the hoofs of both front feet became loosened, and discharged blood and serum. This condition probably accounts for the high temperature from this time on.

In order to determine whether or not the introduction into the circulation of large quantities of plain broth would produce any symptoms, this horse was inoculated Jan. 26, 1903, at 10 a. m., intravenously into the jugular vein with 300 c. c. of plain broth. No symptoms or elevation of temperature were noticed.

Jan. 30, 1903, at 10:15 a. m. the animal was inoculated intravenously into the jugular vein with 275 c. c. of a 24-hour broth culture of *B. pyrogenes equinus*, obtained from the jugular blood of swamp fever Case No. 12. At 11 a. m. the horse went down, and there was labored, rapid respiration and considerable uneasiness. The animal remained in this condition during the afternoon, the temperature gradually falling to 98.6° F. at 5 p. m., the last time it was taken. The horse was found dead the next morning.

HEART OF EXPERIMENTAL HORSE NO. 10.

The hemorrhages are easily seen both under the epicardium and endocardium.

(See autopsy notes, page 365.)

The autopsy notes are as follows:

Some peculiar areas of yellow œdema were found in the fascia of the latissimus dorsi muscle. There were several large hemorrhages about the borders of the lungs, especially anterior borders and several large air bullæ. Some of these bullæ contained blood. Upon the pericardium was a large mass of this peculiar yellow gelatinous substance also stained with blood. The heart muscle contained many hemorrhages upon its external and internal surfaces. (See cut opposite page 364.) The interior of the left ventricle was nearly a solid mass of blood, some being in the coronary vessels, but most of it in the muscular tissue. The liver was very much congested, but otherwise appeared normal. The spleen was large and mottled over its entire surface with hemorrhages. (See cut opposite page 366.) About both kidneys were large masses of this thick, yellowish œdema. The right adrenal body was markedly hemorrhagic. The kidneys themselves, were slightly congested, but not hemorrhagic. The mesenteric artery for about three inches after leaving the abdominal aorta was thickened and tortuous. This near the surface was very much roughened and contained many small worms (*strongylus armatus*).

Cultures were made from the heart's blood, kidney, lung, spleen and liver.

Cultures from the heart's blood showed a yellow staphylococcus and *B. pyrogenes equinus*.

Cultures from the kidney showed streptococcus and *B. pyrogenes equinus*.

Cultures from the lung, spleen and liver showed *B. pyrogenes equinus* in pure culture.

Experiment Horse No. 11.—An old, thin black mare, in poor condition, weight about 850 pounds.

Jan. 20, 1903, blood examination was as follows:

Hæmoglobin (Tallquist), 100; red cells, 6,288,000; leucocytes, 14,000.

Blood examination, Jan. 23, 1903, was as follows:

Hæmoglobin (Tallquist), 100; red cells, 6,560,000; leucocytes, 18,000.

Jan. 23, 1903, at 11:30 a. m., this horse was inoculated intravenously into the jugular vein with 270 c. c. of *B. pyrogenes equinus* obtained from the jugular blood of swamp fever Case No. 12.

At the time of inoculation the precaution of filling the rubber tubing leading from the flask to the needle was not taken, so that it was known that several c. c. of air entered directly into the

jugular vein. The horse died at 4:30 p. m., same date. Autopsy held at once. Autopsy notes are as follows:

The lungs contained several air vesicles. They dented easily and crepitation was more marked than common. They contained many hard, small dark nodules, such as Dr. Brimhall had seen in old glanders cases.

The right side of the heart contained a large chicken-fat clot; also frothy blood. The left side contained dark fluid blood, but no air bubbles. Upon sectioning the heart muscle, frothy blood oozed from the small vessels. The endocardium showed many small hemorrhages. The spleen appeared to be normal. The liver was apparently normal, but upon section bloody froth oozed from the cut surface. The right kidney contained a large cyst in its cortex, about three inches in diameter. This was filled with a clear, straw-colored fluid. Several smaller cysts were found through the cortex, and several cysts were also found in the left kidney. The mesenteric artery immediately after leaving the abdominal aorta was thickened, tortuous and contained many small worms (*strongylus tetracanthus*).

Cultures were taken from the lung, heart's blood, liver, spleen and kidney. From the lung, *B. subtilis* was obtained. From the heart's blood, a white staphylococcus, and from the liver, spleen and kidney, colon bacillus.

Experiment Horse No. 8.—An old, weak brown mare, weight about 1,000 pounds. This animal was inoculated intravenously into the jugular vein at 12:05 p. m., Jan. 12, 1903, with 230 c. c. of a 24-hour broth culture of *B. pyrogenes equinus*, obtained from the jugular blood of swamp fever Case No. 12. The animal went down while being inoculated, and died in 10 minutes. It would seem therefore, that the animal's heart was not able to stand the extra strain placed upon it by the sudden introduction of such a large quantity of fluid directly into the circulation, or that it died from an embolism caused by a small particle of some kind in the broth. It will be remembered that this organism forms a heavy sediment when grown in broth. The following blood examination made immediately before the inoculation shows that the animal was not in good health:

Hæmoglobin (Tallquist), 90; red cells, 8,628,000; leucocytes, 41,-000.

No autopsy was made.

SPLEEN OF EXPERIMENTAL HORSE NO. 10,

which succumbed in less than twenty-four hours after an intravenous inoculation (275 c. c.) of a twenty-four hour broth culture of *B. pyrogenes equinus.* The hemorrhages appear as dark spots in the photograph and are very numerous. (See autopsy notes, page 365.)

Summary—

1. Large doses of *B. pyrogenes equinus* (275 c. c. fresh broth culture), when given intravenously, produced the death of the animal in less than 20 hours. Immediately following the inoculation, labored rapid respiration, considerable uneasiness, with initial rise of temperature were exhibited, the animal being unable to stand. (Experiment Horses Nos. 10 and 11.)

2. Repeated small doses (10 to 20 c. c.), see Experiment Horse No. 9, produced marked hyperpyrexia, polyuria, synovitis, œdema on the belly and progressive weakness, so that the animal was killed about six weeks after inoculation. The red blood cell count was decreased, the leucocytes increased, and the hæmoglobin remained the same.

3. At autopsy following large doses, very marked hemorrhagic lesions, and yellowish gelatinous œdema were seen.

4. Animals inoculated with repeated small doses showed at autopsy superficial abscesses. Hemorrhages and thick gelatinous œdema were found in the internal organs.

Demonstration of the Difficulty of Recognizing and Isolating B. Equisepticus When Mixed With B. Pyrogenes Equinus—Pathogenesis for Horses of the Mixture of the Two Organisms.

Experiment Horse No. 6 was an old, weak black horse, in poor condition. Weight about 900 pounds.

The blood examination on Jan. 2, 1903, immediately before inoculation was as follows:

Hæmoglobin (Tallquist), 80 to 100; red cells, 3,476,000; leucocytes, 7,000.

The animal was inoculated intravenously at 11:45 a. m. on this date, with 265 c. c. of a 24-hour broth culture of what was thought to be pure *B. pyrogenes equinus*, obtained from the spleen of Rabbit No. 588 (first passage through animals from Case 11).

At 3 p. m., the horse had slight rigors, and its hind legs were trembling. The respiration was rapid and labored. By 3:20 p. m. the animal was down and could not be made to get up. At 3:45 p. m. the horse was standing up and appeared better. The temperature reached the highest point at 6:30 p. m., when it was 104.8° F.

The following day the animal appeared much improved, although the temperature remained above 103°. On the second day the horse seemed to be in about the same condition, although the temperature reached 104.4° F. at 11 a. m.

On the morning of January 5th, the third day after inoculation, the horse was found dead.

Autopsy Notes.—Under the skin on the side which was uppermost at the time of death, many hemorrhagic lesions, about one-half inch to one inch in diameter were found in the area over the ribs. The lungs contained many small hemorrhages about the size of peas. A small hemorrhagic area was noticed on the lower portion of the pericardium. The heart muscle contained several hemorrhages one-half to one inch in diameter. The spleen was small and apparently normal, weight three pounds. The liver was apparently normal, weight 14 pounds. The ductus venosus was large, and not entirely closed. There was a thick mass of connective tissue and fat over the bile duct. The stomach and intestines contained several large hemorrhages. The intestines at the point of the hemorrhages looked as if ulcerated and about to perforate. The mesenteric glands were hemorrhagic and enlarged. Attached to the peritoneum on the mesentery, there was a tumor about two inches long and one inch thick, covered with a hard fibrous capsule containing a calcareous deposit. The mesenteric artery contained several aneurisms; also organized clots and worms (*strongylus tetracanthus*). The right ischium was fractured, probably due to struggles in the stall or falling on the cement floor.

Bacteriological Findings.—Cultures were made from the liver, kidney, spleen, lung and heart's blood.

B. pyrogenes equinus was obtained in pure culture from the liver, kidney and spleen.

B. pyrogenes equinus, mixed with *B. equisepticus*, was obtained from the lung and heart's blood.

This case is particularly instructive, from the fact that a supposedly pure organism, *B. pyrogenes equinus* was grown upon various media and passed through two animals, and yet later found to be mixed with *B. equisepticus*, and this, by workers who were familiar with the members of the hemorrhagic septicæmia group.

Rabbit No. 588, from which the culture for inoculating Horse No. 6 was obtained, was inoculated with a culture of *B. pyrogenes equinus* (supposedly pure), obtained from the spleen of swamp fever Case No. 11. At the autopsy of the rabbit, the same organism was recovered in seemingly pure culture. This culture was placed in the culture closet Nov. 18, 1902, and kept at a temperature of about 20° C., until Jan. 1, 1903 (44 days), when sowings were made to obtain a fresh culture for inoculating Experiment Horse No. 6. This horse was inoculated Jan. 2, 1903, and died three days later (Jan. 5, 1903). From the cultures taken at the autopsy of the

horse, *B. pyrogenes equinus* was recovered, but mixed with *B. equisepticus.*

On obtaining these results, the supposedly pure culture of *B. pyrogenes equinus,* obtained from the rabbit mentioned above (No. 588), and used for inoculating Experiment Horse No. 6, was carefully examined, and found to contain *B. equisepticus* also. Therefore, it would seem that the two organisms had been mixed in the original and apparently pure cultures of *B. pyrogenes equinus* obtained from swamp fever Case 11, and had been passed through Rabbit 588, recovered at autopsy, and inoculated into Experiment Horse No. 6, the presence of *B. equisepticus* being unnoticed even by those familiar with it.

As mentioned above, the case illustrates the *extreme* difficulty encountered in recognizing and isolating the members of the hemorrhagic septicæmia group, especially when they are mixed with other bacteria, which resemble them in morphology, or grow abundantly on ordinary media.

Toxine Experiments.—*B. equisepticus.*—In order to determine whether this organism produced a soluble toxine or not, the following experiments were conducted:

A small flask of plain broth was inoculated with *B. equisepticus* obtained from Rabbit 708 (seventh passage through animals), and incubated for 24 hours. Rabbit No. 714, weight 710 grammes, was inoculated intravenously with 0.5 c. c. of this culture. It died in less than 16 hours, and the organism was recovered in pure culture from the heart's blood and liver. The flask was then incubated for 5 days, when Rabbit No. 717, weight 1,140 grammes, was inoculated intravenously with 1.0 c. c. of the culture. This animal also died in less than 16 hours, and the organism was obtained in pure culture from its heart's blood and liver.

This five-day culture was then divided into two parts. Part No. 1 was filtered through a sterile Pasteur filter, and the filtrate collected in a sterile glass bulb. Cultures were made into broth, and upon agar from the filtrate, and placed in the incubator. At the end of 48 hours there was no growth. When it was found that no bacteria had passed through the filter, Rabbit No. 719, weight 940 grammes, was inoculated intravenously with 5 c. c. of the filtrate. The rabbit showed no symptoms, and was used again 78 days after.

Part 2 was shaken up with an excess of chloroform and placed in the ice chest for 24 hours. The flask was then placed in a water

bath, heated to 45° C. under reduced pressure, and the chloroform vapor drawn off with a water pump. When the odor of chloroform could no longer be detected, cultures were made and incubated 48 hours. No growth appeared. Rabbit No. 728, weight 1,150 grammes, was then inoculated intravenously with 1 c. c. of this killed culture. The rabbit showed no symptoms, and was used again 27 days later.

Another flask of broth was inoculated with *B. equisepticus*, obtained from Rabbit No. 718 (eighth passage through animals), and placed in the incubator. When the culture was 24 hours old, Rabbit No. 724, weight 585 grammes, was inoculated intravenously with 0.2 c. c. It died in less than 16 hours, and *B. equisepticus* was obtained from its heart blood and liver in pure culture. The culture was then incubated until 48 hours old, when it was divided into two parts.

Part 1 was filtered through a sterile Pasteur filter—cultures were made from the filtrate and incubated for 48 hours, but showed no growth. Rabbit No. 736 (weight 1,850 grammes), was inoculated intravenously with 5 c. c. of this filtrate, but showed no symptoms, and was used again 20 days later.

Part 2 was shaken up with an excess of chloroform and placed in the ice chest for 24 hours, then heated to 45° C. in a water bath under reduced pressure, and the chloroform vapor drawn off with a water pump. When the odor of chloroform could no longer be detected, cultures were made from the remaining broth and incubated for 48 hours. No growth appeared. Rabbit No. 738 (weight 2,250 grammes) was inoculated intravenously with 2 c. c., and Rabbit No. 737 (weight 2,000 grammes) in the same manner with 5 c. c. of this killed culture. Neither rabbit showed any symptoms, and they were used again 15 days later.

Conclusions.—It will be seen from the above experiments that while 0.2 c. c. and 0.5 c. c. of a 24-hour broth culture, and 1 c. c. of a 5-day broth culture of the organism, killed rabbits in less than 16 hours, when they were inoculated in the same manner with 5 c. c. (5 to 25 times as much) of the filtrate, or cultures killed with chloroform, no symptoms developed.

Reference to Table IV. will show that a dose of 0,0000000.1 c. c. of a fresh broth culture of *B. equisepticus* of this same strain was sufficient to produce lethal results.

B. pyrogenes equinus.—These experiments were begun to determine whether or not *B. pyrogenes equinus* forms a soluble toxine, but on account of the pressure of other work the experiments

had to be abandoned before any definite conclusions could be obtained. Rabbit No. 696 was inoculated intravenously with 1 c. c. of a 24-hour broth culture of *B. pyrogenes equinus*, obtained from the spleen of Experiment Horse No. 9. The animal showed no symptoms, and is alive and well at the present time (four months after inoculation). Another rabbit, No. 726, was inoculated intravenously with 1 c. c. of a 24-hour broth culture of *B. pyrogenes equinus*, obtained from the same source as that used for the above rabbit. This animal died within 24 hours, and *B. pyrogenes equinus* was regained at autopsy, in pure culture.

A small flask of broth was inoculated with the same strain of *B. pyrogenes equinus*, used for inoculating the two rabbits mentioned above. When the culture was 48 hours old it was filtered through a sterile Pasteur filter, and the filtrate collected in a sterile glass bulb. Cultures were made from the filtrate and incubated for 48 hours. No growth appeared. When it was found that no bacteria had passed through the filter, Rabbit No. 693 was inoculated intravenously with 1 c. c. of the filtrate, and Rabbit No. 94 was inoculated in the same manner with 5 c. c. of the filtrate. Rabbit No. 693 showed no symptoms, and was used again 49 days later. Rabbit No. 694 was found dead two days later. No bacteria developed in the cultures taken at autopsy.

It will be seen from the above that two rabbits were inoculated with 1 c. c. each of a 24-hour broth culture of *B. pyrogenes equinus;* one of them died in less than 24 hours, and the organism was recovered at autopsy, while the other one showed no symptoms during the four months it was kept under observation.

Two rabbits were inoculated with the sterile filtrate, the one inoculated with 1 c. c. showed no symptoms during the 49 days it was under observation, while the one inoculated with 5 c. c. of the filtrate died in 48 hours, and no bacteria were found in the cultures taken at autopsy.

Conclusion.—From the above experiment it would appear that *B. pyrogenes equinus* forms a soluble toxine capable of producing death in rabbits if given in a sufficiently large dose; but since the work could not be carried on at present or the results confirmed or disproved by further experiments, no definite opinion can be expressed at this time.

Prophylaxis.—Experiments extending over a period of more than two months have been in progress to ascertain the possibility of producing an antitoxic serum by the inoculation of killed cultures of *B. equisepticus*.

Experiment horse No. 13 and a series of six rabbits have been repeatedly inoculated with broth cultures of *B. equisepticus*, which had been killed by heat. Five hours after each injection (intravenous) into the horse, the temperature of the animal was elevated 5 or 6° Fahrenheit, although it dropped to normal on the following day. No other symptoms were noted.

The incompleteness of this line of investigation precludes the possibility of making any more definite statements at this time, although it is hoped that further report on this phase of the question may be made at a later date, when the work now in progress is completed.

SUMMARY.

1. A disease popularly called "swamp fever," usually chronic in nature and characterized by insidious onset, loss of condition, irregularly periodic fever, progressive emaciation and anæmia, unimpaired or voracious appetite, development of "staggering" gait, and in many cases polyuria, has been found to exist in two foci in Minnesota.

2. Little has been found which tends to show the means by which it is spread. Insufficient evidence has been secured to justify the popular name.

3. The disease is usually fatal, the mortality being about 80 per cent.

4. Reports of the loss on 26 farms of 136 horses within two to seven years, in an area about two miles wide by six miles long, near Beltrami, justifies the suspicion that other localities in the same district, if carefully investigated, might reveal a similar condition of affairs.

5. In the 18 outbreaks here reported, 21 autopsies have been held. From the tissues, blood and fluids, a micro-organism, belonging to the hemorrhagic septicæmia group and described in this report as *B. equisepticus*, has been demonstrated positively in 17, and probably in two others, i. e., in 19 out of the 21 autopsies. Widespread contamination of the cultures made in one of the two remaining cases, and the fact that the last case was one of recovery, probably account for failure to demonstrate *B. equisepticus* in them.

6. *B. equisepticus* is the most virulent micro-organism for rabbits ever studied in this laboratory. For horses it is also virulent. The symptoms and pathological lesions of the disease were fairly well reproduced by experimental inoculation of horses, with recovery from the fluids and tissues of *B. equisepticus* in pure culture.

7. An etiological relationship between *B. equisepticus* and the disease "swamp fever" would therefore seem to be a safe deduction from the autopsy findings in clinical cases and the experimental inoculations.

8. The demonstration of another micro-organism, here described as *B. pyrogenes equinus* in six cases of "swamp fever," but limited to two farms, does not permit of its consideration at this time as an etiological factor in this disease, although it has never been met with in any of the investigations of this board, except in these six cases of "swamp fever," and although in experimental inoculation symptoms and lesions were produced, which are comparable to those of "swamp fever."

9. Relative to the distribution of this disease outside of Minnesota little can be said. In Manitoba a disease known as "swamp fever," and resembling that met with in Minnesota, has not yet been shown to be etiologically identical. "Bottom disease" in the valley of the Missouri should be thoroughly investigated, and the presence or absence of *B. equisepticus* determined.

Lignières has somewhat vaguely described the occurrence of a group of diseases, "Pasteurellose equine" occurring in Europe and South America as due to "bacilles ovoides" (*B. equisepticus ?*), but whether "swamp fever," as observed in Minnesota, has ever been seen by Lignières cannot be determined from his description.

10. The pathology of "swamp fever" would seem to be a septicæmia, accompanied by great destruction of red blood cells, inflammations and hemorrhages of serous membranes and degenerations and hemorrhages in glands and tissues, whilst pus formation is frequent. Certain findings would seem to point to the alimentary tract as the *atrium* of infection, but much remains to be worked out before positive statements can be made.

11. Protective and curative measures have not yet been formulated, owing to the impossibility of concluding investigations now under way, in time to be included in this report.

12. A later report will be made when the pathological material now on hand has been worked up and the experimental investigations dealing with means of transmission of the disease and curative or preventive treatment based on laboratory methods have been completed.

13. The investigations here reported illustrate the very great necessity of the fullest collaboration in field and experimental work between veterinary and laboratory observers in the study of

an unknown disease. At times it is desirable to be able to concentrate a whole laboratory staff on such problems.

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This board wishes to express its appreciation of the spirit of collaboration exhibited by Drs. Gordon Bell and Frederick Torrance, of Winnipeg, as well as by other Canadian investigators. Through them this board was afforded an opportunity of studying cases of "Swamp Fever" in Manitoba, and but for an unforeseen accident a more accurate comparison of the etiology of the disease in Manitoba and Minnesota would have been possible. The very careful study of the disease by Drs. Torrance and Bell afforded practically the only information available in America, and their work has aroused an interest which should not be allowed to abate until all phases at present in obscurity are cleared up.

NOTE.—Since this report was placed in the hands of the printer, an article on "Equine Malaria and Its Sequelae," by A. Theiler, Bacteriologist to the Transvaal Government, has appeared in the June 30, Vol. XVI., No. —, Journal of Comparative Pathology and Therapeutics, page 97 et seq.

The South African disease described in this article is due to a parasite, the "*pyroplasma equi.*" The author believes that invasion by this parasite predisposes to a symbiotic and secondary infection by a specific bacillus, which from his description would appear to have certain points of resemblance both to *bacillus equisepticus* and to *bacillus pyrogenes equinus*, but not to be identical with either.

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